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Excavating Machinery for Ditching and Trenching.*

By E. E. R. TRATMAN,† Assoc. M. Am. Soc. C. E.

Two special classes of excavation are (1) the digging of trenches for sewers, water and gas mains, etc., in streets, and for tile drains in open country; (2) the digging of open ditches and canals for land drainage and irrigation. For extensive work of this kind hand labor is too slow, and different forms of excavating appliances have been adapted to such work, while many machines have been designed specially for these classes of excavation. The conditions under which the work is done vary materially; on the one hand it may be a narrow trench in firm ground (perhaps in a city street where traffic must be interfered with as little as possible); on the other hand it may be a ditch in soft swampy ground, or a canal (in dry ground for irrigation or wet ground for drainage) large enough for a steam shovel or dredge. The purpose of such machines was summarized as follows in an article in Engineering News (Aug. 26, 1909): (1) to improve the facility and rapidity of excavating the work; (2) to reduce the cost of the work; and (3) to reduce the labor troubles which attend work requiring the employment of large gangs of men, especially where the work is at a distance from centers of population.

DRAG AND WHEELED SCRAPERS.—The first step beyond hand excavation is the use of drag (or slip) scrapers and wheeled scrapers. These have been used in many cases. On the experimental farm of the University of Minnesota, at Crookston, Minn., drag scrapers were used for part of the open ditches. The specified cross-section of the ditches was 3 ft. bottom width and side slopes of 1 on 1½. In construction, however, the bottom was made somewhat concave by the scrapers, the 3-ft. width being about 4 or 5 ins. above the grade line. Work done by the contractor's forces averaged 41 to 43½ cu. yds. per scraper per day. Work let to subcontractors ranged higher; an outfit of two teams and three men average 50 cu. yds. per team per day for 10 days. One man with his team averaged 60 cu. yds. per day for six days, and 65 cu. yds. for ten days, but he had six years' experience in ditch work. Rainy weather softened the earth so that it was hard to pull out the scrapers, and partly finished sections would fill with water so that they had to be abandoned and work started in new places. These pocketed sections were very hard to finish, the bottom being so saturated and slushy.

FIG. 1. A DRAG-LINE EXCAVATOR ON IRRIGATION CANAL WORK.

Lidgerwood Mfg. Co., Chicago, Builders.

The ordinary wheeled scraper has a single pair of wheels and a pan of 9 to 15 cu. ft. capacity. The Maney scraper* is a much larger machine, mounted on four wheels and having a scraper or bucket of 1 yd. capacity. The article in Engineering News which has been mentioned above suggested the possibility of the design of motor-wheeled scrapers. With the four-wheeled horse-operated scraper of large capacity and the remarkable development in motor trucks for heavy hauling, such a machine appears to be quite practicable.

ROAD GRADER AND DITCHER.—This machine consists of a scraper blade suspended from a frame mounted on wheels and capable of being set at any desired angle in both a horizontal and a vertical position. It has been used on irrigation work, and some makes are specially fitted to enable them to work on the slope of a cut. For narrow ditches, such as laterals, the machine may work with the wheels on one side in the ditch and those on the other side upon the surface of the ground. This type of machine is adapted more particularly for work in dry material.

ELEVATING GRADER.—This machine turns up the soil with a plow and delivers it upon an inclined lateral belt conveyor from which it is discharged into wagons for removal or upon the ground as a spoil bank or levee. The machines have been used very extensively on irrigation canals and ditches, and to some extent also on drainage work. On the Minnesota University farm (mentioned above) an elevating grader averaged 450 cu. yds. per day on one section and 1,000 cu. yds. per day on another section. In rainy weather, however, the soil became so soft that the machine could not be used. The machine was operated by 16 horses and four men, and its elevator or conveyor belt was driven by a 12-HP. gasoline engine. The weight was 5 tons.

FIG. 2. A TRENCH EXCAVATOR OF THE CHAIN TYPE.

The Municipal Engineering & Contracting Co., Chicago, Builders.

In a report on this work it is stated that the average speed was 1.3 miles per hour, with a consumption of 12 gals. of gasoline for a 10-hour day. The machine would work on a slope where one wheel was 3 ft. lower than the other, but on slopes the grader would slip, making it hard to keep a continuous cut. It is stated also, that the elevating grader can be used to advantage as a ditching machine only in soils dry enough to work with an ordinary plow, and in long sections of wide shallow ditch, or for removing the top portion of a deep ditch.

STEAM SHOVELS.—The steam shovel has been used extensively on irrigation canal and ditch work, but to a limited extent only on drainage work, where the material is usually soft and wet. It has been used in a number of cases for the excavation of sewer trenches. For this work it may travel on its road wheels,* or it may be removed from the wheels and placed upon a platform spanning the trench, being hauled forward by a cable anchored ahead and operated by a drum on the machine. The platform arrangement is often preferable, as the machine is steadier it is closer to the ground and it reaches to a greater depth.

The ordinary steam shovel remains stationary while the boom swings to either side, covering an angle of over 200°. The revolving shovel is built like a locomotive crane, with the boom, engine, boiler, etc., all mounted on a frame which revolves (through 360°) upon a turntable carried by the truck frame. A special form of Vulcan steam shovel for trench work had a downward extension from the head of the boom. The dipper handle was carried at the lower end of this extension and the cutting motion of the bucket was made towards instead of away from the machine. The boom was 30 ft. long, with a 27-ft. dipper handle and 1¼-yd. bucket. These machines were very successful on work in open country, but the great length of boom was an objection for work in city streets.

*Abstract of a paper read at the annual meeting of the Illinois Society of Engineers and Surveyors, at East St. Louis, Ill., Jan. 25-27, 1911.

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*Engineering News, May 19, 1910.

*Engineering News, Jan. 12, 1911.

SCRAPER BUCKET OR DRAG-LINE EXCAVATORS.—This is a type of machine which has been developed extensively in very recent years, and is well adapted to ditch and trench work of various kinds. It consists essentially of a scraper or bucket handled by a cable and hoisting engine instead of by horses. The machines may be divided into three classes: (1) with the bucket handled by a derrick car or locomotive crane; (2) with the bucket handled by lines from traveling towers; (3) with the bucket handled by a cable leading from the hoisting engine to an anchorage and then back to the engine. The former class is that generally used, and there are numerous makers.

The Lidgerwood machine* is shown in Fig. 1. This has the hoisting line led over the end of the boom and attached to the bucket bail. The hauling line is led directly to the ring of a chain bail at the mouth of the bucket, and a short line runs from this ring up to a sheave in the suspending bail and then down to the back of the bucket. As long as the hoisting line is kept taut the bucket is held horizontal. When this line is slackened, the bucket is free to tilt forward in the bail. The bucket is a rectangular box. Two of these machines, with revolving derrick cars handling the buckets, were used in building a levee along the Mississippi River near New Boston, Ill. These had 60-ft. booms and 1½-yd. buckets. The working force included an engineman, fireman, 2 men to shift the track, 2 men to dress the top of the levee to proper shape, and a few men in advance to level the ground for the track. Other machines have been used in government irrigation work, on the canal of the LaCrosse Water Power Co. (Wisconsin), the New York State Canal, and a drainage canal through a cypress swamp in Louisiana. They are in use on the new drainage canal for flood protection work near East S. Louis, Ill.; here they work in pairs, the two machines covering the width of the canal and levees.

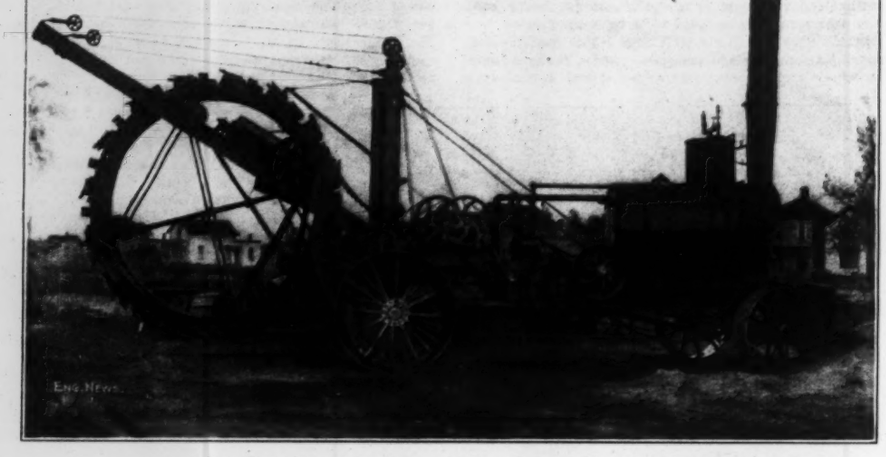

FIG. 3. A STEAM TRENCH EXCAVATOR OF THE WHEEL TYPE (WHEEL RAISED).
The Buckeye Traction Ditcher Co., Findlay, Ohio, Builders.

The Heyworth or Bucyrus machine† has a semi-cylindrical bucket, with a rigid hauling bail which holds the bucket in its cutting position so as to make a positive cut of desired depth. The bucket is suspended by a chain swung from a hoisting block, and is dumped by the hoisting line. This line passes under the sheave of the block and then over a sheave at the end of the boom, returning then to an attachment at the back of the bucket. When the bucket is hoisted, an additional pull on the line raises its rear end so as to discharge the contents. These machines have been used on the North Shore drainage channel at Chicago. They have been used also on a drainage canal in California, excavating 35,000 to 45,000 yds. per month. The canal was 150 ft. wide at the bottom, and the excavated material (black soil, shale and stiff yellow clay) was used to form levees. The machines had 3½-yd. buckets slung from 110-ft. booms, and used oil fuel.

The Channon machine‡ has a rectangular bucket with two rigid bails; these are so connected that as the bucket tilts in dumping, the front (horizontal) bail is swung up out of the way of the falling load. It has been used on Government irrigation work, for backfilling sewer trenches in Chicago, and for building levees near Pekin, Ill. The Avery machine is a traction engine fitted with a small wheeled platform in the rear, on which are an A-frame, boom and hoisting engine for the bucket lines.

The Bagley grader‖ is of the type in which the cable is operated by a stationary engine. One cable is led to a block on an anchor or deadman set ahead of the machine, and then back to the rear of the bucket. The other cable is led directly to a bail at the mouth of the bucket. The bucket can thus be hauled to and fro. The Hammond* power scraper is very similar.

A drag-line excavator with two towers was built by Mr. J. T. Fanning (Chicago) for his contract on the North Shore drainage channel. The tops of the towers were connected by lines spanning the cut and at the bottom of the land side of each tower was an inclined boom extending to the spoil bank. Lines on each tower operated a bucket which made a cut on the slope and then ran out on the boom to dump its load. The Field scraper excavator used on the New York State Canal, had the engine mounted on a car which traveled along the cut and carried a tower 75 ft. high. One cable was led over a sheave at the top of the tower, then across the cut to an anchored snatch block and then back to the bucket. The other cable led over a sheave 30 ft. up the tower and thence to the front of the bucket. The spoil bank was formed between the cut and the machine. The bucket had a capacity of 2 cu. yds.

The Heffron trenching machine† consists of a traveling frame which carries a steam hoisting engine and a dumping platform. At about 100 ft. from the machine is a snatch block in the trench. From one drum of the engine, a cable extends to the snatch block and back to the rear end of the scraper bucket. Another cable is attached to the front bail of the bucket and led to the second drum of the engine. In this way the bucket is hauled to and fro. When loaded, it is hauled along the trench and up the incline to the dumping platform.

GRAB BUCKETS.—Orange-peel and clamshell buckets have been used in a number of cases for trench, ditch and canal excavation, and for building levees.‡ They are handled by locomotive cranes, derrick cars or floating dredges. Part of the Illinois & Mississippi Canal, in Illinois, was excavated by orange-peel buckets handled by traveling derricks with 90-ft. booms, and similar machines have been used on the Government irrigation canals and the New York State Canal. Sewer trenches in Chicago, Louisville and Boston have been excavated in this way.

Ditching and Trenching Machines.

All the machines thus far described are used for various kinds of excavation besides ditch and trench work. We come now to machines which have been designed specially for this particular kind of work. These may be divided into three classes: (1) endless chain excavators, acting on the principle of a ladder dredge (but excavating on the inside upstroke, where the chain lies against the breast of the work) (2) wheel excavators; (3) miscellaneous.

CHAIN EXCAVATORS.—Prominent among these is the Chicago trench excavator,‖ which resembles a combination of a traction engine and a ladder dredge (Fig. 2). The ladder frame is at the rear of the engine and is held down to its work by rack bars and pinions. Upon this frame travel endless chains carrying a series of cutters and scrapers. The machine will excavate trenches 6 to 20 ft. deep and 1 to 5 ft. wide. It is used both for sewer-pipe and drain-tile work. Behind the ladder-be a box or shield to protect the tile-layer against ca This box also may have a curved chute for laying tile in place automatically, the men on the surface ply keeping the chute full. The buckets discharge excavated material upon a transverse belt conve which delivers it in a pile beside the trench, ready the backfilling. Some of the machines are operated gasoline engines, and for use on soft or wet ground rear end is supported by a caterpillar traction in of the usual wheels. This consists of a pair of end chains carrying transverse planks, the chains run over two sprocket wheels, one of which is driven from engine.

One of these machines, at Denver, averaged 70 per 10-hour day for three months; the depth was 7 to 10½ ft. The maximum daily records were ft. of trench 7½ ft. deep and 1,050 ft. of trench deep. The cost of operation per day was $15.50; o ator, $6; helper, $2.50; ¾ ton of coal (at $8), $6 pairs, $1.

The Parsons machine is of very similar design the ladder frame and conveyor belt are carried b separate two-wheeled truck coupled behind the m portion which carries the engine and driving mechani They are built with both steam and gasoline engine and power is transmitted to the mechanism by sprocke chains. The machine weighs about 20 tons. It can cu trenches of various widths, as the ladder frame may be given a slow reciprocating motion transverse to the line of the trench. The Monahan machine more nearly resembles the Chicago machine, but has numerous special details of its own. It weighs 30 tons and is operated by a 100-HP. gasoline engine.

The Hoviand machine is designed more especially for ditching and tiling in soft and wet ground. For this reason it is built in two separate parts, one carrying the engine and driving mechanism, and the other carrying the excavator and conveyor. Power is transmitted to this latter part by driving chains. Each part is mounted upon a caterpillar traction device instead of upon wheels. A 45-HP. or 60-HP. gasoline engine is used. Close behind the ladder frame is a curbing or shield for the protection of the tile layers, and this has a hoist for handling large pipes. Tile up to 12 ins. diameter may be laid automatically by a curved chute fitted inside the shield. A foreman, engineman and two or four laborers form the working force. In Iowa, the machine has been used to lay 30-in. pipe in a trench 8 ft. deep for draining a slough.

The Helm machine* is also of the continuous bucket type, but the chain works vertically on a telescopic frame. The ascending side of the chain is diverted by sheaves to a horizontal run over the end of the conveyor and then returns to the top of the vertical frame. This machine has been used by the Laclede Gas Co., of St. Louis, to excavate trenches for 24-in. gas mains. The trenches are 3 ft. wide, and as deep as 17 ft. At Belleville, Ill., it has been used in excavating for a 12-in. pipe sewer; the trench is 26 ins. wide, with a depth varying from 9 ft. to 15½ ft.

Work was begun on Oct. 19, 1910. The material was found to be exceptionally sticky, but the machine advanced at such a rate that it had to be stopped at times to let the pipe-layers catch up and so enable some of the back bracing to be removed and brought ahead. In 5¼ working hours the machine made an advance of 280 ft., the depth being 15 ft. The material became so bad that it was necessary to sheath the trench almost solid. It was almost impossible to keep it from caving below the 7-ft. level, and a stream of water was running continuously in the bottom of the trench. The machine could advance only 8 to 12 ins. at a time, and then stopped while a set of braces was put in. Each stop allowed the water to collect under the buckets, which then churned and puddled the mass very badly.

The machine was handled by an engineman and fireman, and used 20 to 25 bushels of coal in 10 hrs. Behind the machine there were 2 men laying pipe (one working in water 6 ins. deep or more), 3 men doing the bracing (2 in the trench and 1 on top). There were several men also removing the braces, and others (with a team and scraper) doing the backfilling. They got out about half of the braces, and then the sides would cave, crushing and burying the remainder. This caused a large loss in lumber.

WHEEL EXCAVATORS.—Of excavators of the wheel type, the Buckeye machine† is perhaps the most widely known and used. This, shown in Fig. 3, consists practically of a traction engine having at its rear end a large wheel which is fitted with cutters and which can be raised or lowered to give the required depth of cut. The wheel has no axle or spokes, but revolves on a fixed frame carrying at four points friction rollers bearing against the inner face of the rim. At the top of the wheel the earth is dropped upon a lateral belt conveyor, the end of which projects underneath the rim. The machines will cut to a depth of 12 ft. They have been used extensively in this country, and some have been built for use in Africa, South America, etc. The buckets

*Engineering News, March 21, 1907.
†Engineering News, Oct. 29, 1908.
‡Engineering News, March 21, 1907.
‖Engineering News, March 21, 1907.

*Engineering News, Oct. 20, 1904.
†Engineering News, Aug. 5, 1909.
‡Engineering News, Sept. 22, 1910; May 28, 1903.
‖Engineering News, Feb. 2, 1905; Dec. 24, 1903; Sept. 19, 1901.

*Engineering News, April 19, 1906.
†Engineering News, Aug. 6, 1903.

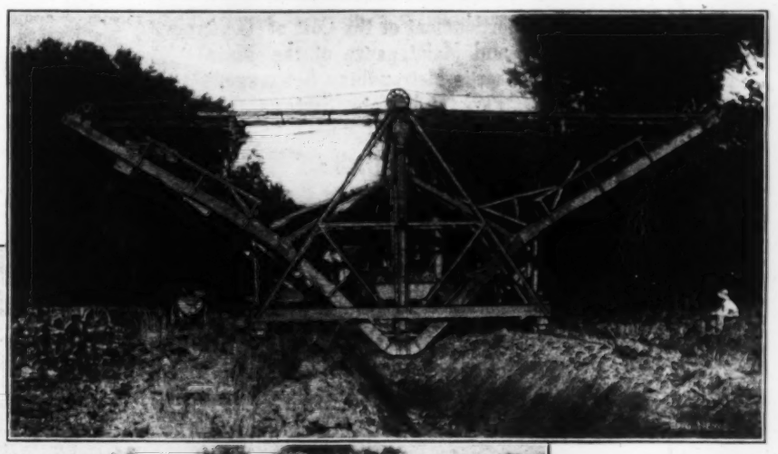

FIG. 5.
A BUCKEYE EXCAVATOR FOR OPEN DITCHES (CUTTING TO A TEMPLATE FOR THE CROSS-SECTION).
The Austin Drainage Excavator Co., Chicago, Builders.

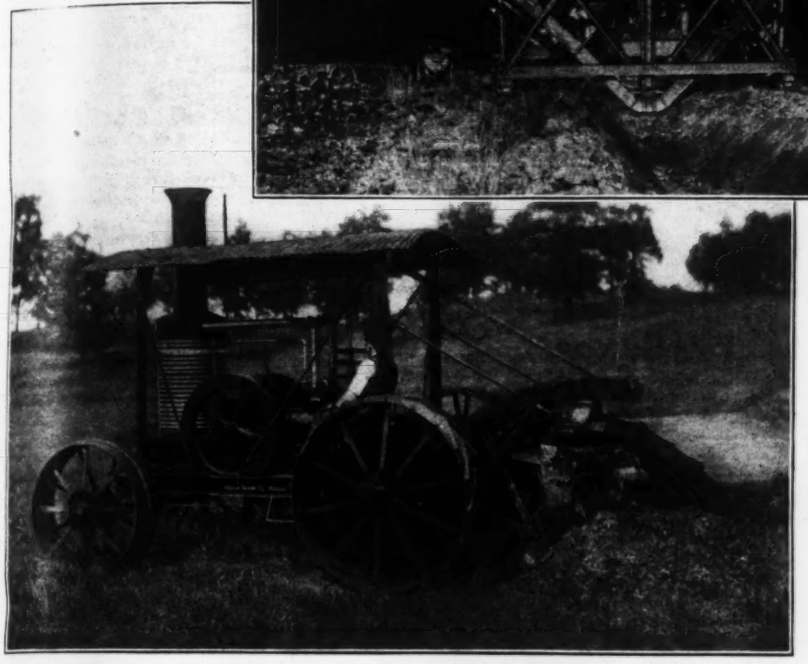

FIG. 4. A GASOLINE TRENCH EXCAVATOR OF THE WHEEL TYPE (WHEEL LOWERED).
The American Ditching Machine Co., West Minneapolis, Minn.

are of various shapes. For cutting open ditches with sloping sides, their shape is that of the cross-section of the ditch. If the ground is sticky and wet, the buckets are of basket or skeleton shape, composed of a number of bars. These machines have been used on drainage work in swamps along the Mississippi. A special type of machine for excavating along the side of a pit (as in clay pits for brick yards, etc.) has the wheel at the side of the machine. This will cut a vertical slice 20 ins. wide and 5½ ft. deep.

Of a similar type, but differing in detail, is the American ditching machine, which has a 9½-ft. wheel and is operated by a gasoline engine of 40 HP. The makers state that under ordinary conditions it will dig a ditch 6 ft. deep and 2 ft. wide at a minimum rate of 180 ft. per hour (80 cu. yds.) It is operated by one man. Fig. 4 shows this machine at work, with its excavating wheel in the trench.

Another type of wheel excavator has buckets carried by arms or spokes which extend beyond the rim of the wheel. In the Dalton machine* the arms are pivoted at the hub; as each arm rises from the trench it is released from the rim and swings outward, and dumps the contents of its bucket onto a dump pile or into a wagon. It then swings back against the wheel and is locked to the rim before descending into the trench. These machines have been used in a number of cases around Chicago. The Miller machine† has a 20-ft. wheel with six arms or spokes, set alternately on opposite sides of the rim. Each arm carries an excavating bucket. As the arm comes to a horizontal position, a hinged hopper falls into place beneath the bucket and the bottom of the bucket is released. The contents fall through the hopper upon a lateral belt conveyor.

MISCELLANEOUS EXCAVATORS.—In open ditches and canals for drainage there is often difficulty from the caving and sliding of banks, making a rough and irregular ditch and obstructing the flow of water. This is due largely to the ditch being finished with improper slopes. The Austin drainage excavator (Fig. 5) was designed specially to obviate this trouble by cutting the ditch with proper slopes.‡ The principle of the machine is that two excavating buckets work to and fro across the line of the ditch, traveling upon a template shaped to the desired cross-section, and running out on side booms to dump their contents upon the ground (as for a levee) or into wagons. In Fig. 5 the template is lowered only for the first shallow cut. The machines have been used not only for drainage work, but for cutting a trench 6 to 12 ft. deep, with side slopes 1 on 1½, to receive a 6-ft. steel pipe line for the water supply of Brooklyn, N. Y. In soft ground, the machine may cut to the full depth of the ditch before moving, the template being fed downwards as the work progresses. Then the frame is raised and the machine moved ahead a distance equal to the width of the bucket. In firm ground that will carry the machine well, it may make a continuous cut about 1,000 ft. long for the first setting of the template, and then travel to and fro over this distance till the full depth is completed. In a modification of the Austin machines an endless chain of buckets is placed transversely to the line of the trench, and travels over a template, as in Fig. 6. In both cases, of course, the excavator and machinery are mounted upon a traveling frame.

The Jacobs machine, which is one of the most recent designs, resembles a locomotive crane or revolving derrick car having a curved beam pivoted under the heel of the 40-ft. boom and with its outer end suspended from the head of the boom. Upon this beam a bucket is moved to and fro by cables. This may be used for digging ditches, cleaning out old ditches, digging trenches, etc. At New Orleans the Stevens trench machine has been used in which a ladder frame and lateral conveyor were suspended from the boom of a revolving crane.* The Mahoney ditching machine† travels along the side of the ditch, and has a lateral beam carrying a bucket arm which is parallel with the ditch line. The bail of the bucket is attached to a line on an overhead beam so pivoted that as the bucket is raised it is swung across the machine to be dumped on the far side.

There are several so-called trenching machines, designed particularly for city work, which are simply appliances for the convenient handling of the excavated material. The Carson machine consists of a series of A-frames straddling the trench, connected at their lower ends by horizontal bars and at the top by a line of I-beams. The legs of the A-frames are fitted with wheels, and the whole trestle can be moved ahead bodily. A trolley hoist runs on the I-beam and the bucket cable is attached to this, the cables being operated by a hoisting engine at the end of the trestle. The trolley is run to any point, the hook lowered, bucket raised and carried to the end of the trestle to be dumped. The Potter machine is similar, but with a steel trestle carrying a track upon which rides a truck operated by a cable and carrying the bucket hoist. In some cases the buckets dump their contents for backfilling at the rear end of the trestle. In some trench work the buckets are handled by a cableway. Any of these methods in city work may help materially to facilitate the work, and reduce to a minimum the amount of interference with traffic, as well as to reduce the nuisance resulting from the handling of material along public streets.

Ditching Dredges.

A large amount of drainage ditching is done by dredges. These are of two classes: (1) floating dredges, (2) land dredges, which work on solid ground ahead of the cut. Ladder dredges and hydraulic dredges are rarely used on this kind of work. In some cases clamshell or orange-

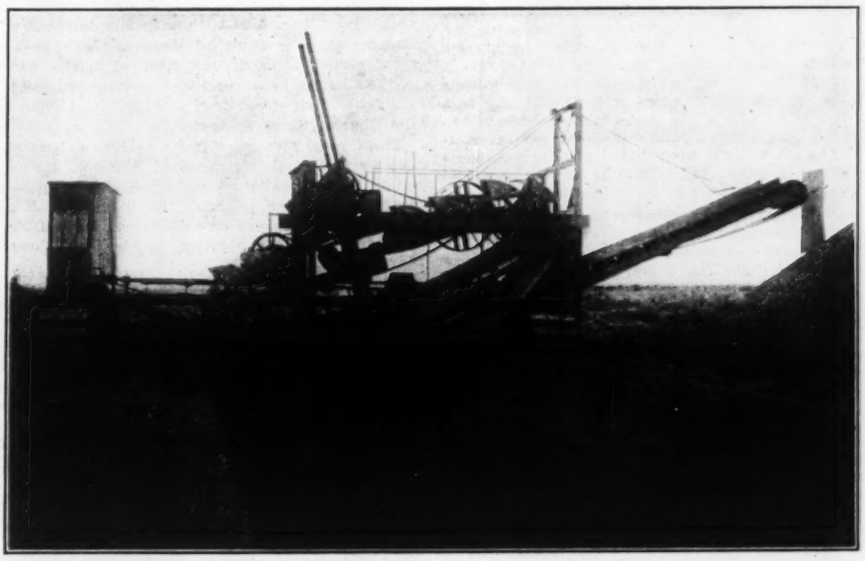

FIG. 6. AN ENDLESS CHAIN EXCAVATOR FOR OPEN DITCHES (CUTTING TO A TEMPLATE FOR THE CROSS-SECTION).
The Austin Drainage Excavator Co., Chicago, Builders.

*Engineering News, July 12, 1900; Feb. 2, 1905.
†Engineering News, Feb. 13, 1908.
‡Engineering News, Sept. 7, 1905.

*Engineering News, Dec. 1, 1904.
†This is developed from a railway ditching machine described in Engineering News, Jan. 7, 1904.

peel buckets are used, but in a majority of cases a dipper dredge is used,* of the type shown in Fig. 7.

To hold the floating machine in position, and to give it a rigid support so that it will not tip or lurch when cutting or swinging a load, it is "pinned up" on spuds. One of these is at the middle of the stern. The others are on either side, near the bow. For narrow cuts, the side spuds are sometimes inclined, extending to shoes on the bank. This gives a wide base of support in swinging. Where the cut is too wide for this, the spuds are vertical and rest on the bottom of the cut. They are raised and forced down either by cables or a rack and pinion. The upper ends of inclined spuds slide in sockets at the top of a transverse gallows frame or are (as in Fig. 7) fitted to shoes on the sides of the A-frame. The former arrangement is used in the Fairbanks, Vulcan and other dredges. The latter arrangement is used on the Marion ditching dredge, the spuds being telescopic in order to provide for adjustment of length.

The new Fairbanks dry-land dredge or walking dredge has its bed or platform mounted on four caterpillars

FIG. 7. A DIPPER DREDGE FOR DRAINAGE DITCH EXCAVATION.
The Vulcan Steam Shovel Co., Marion, Ohio., Builders.

or endless plank tractions, one at each corner. On this are two booms, the lower one carrying a bucket which swings on bearings and cuts towards the machine. This boom is suspended from the main boom and is lowered and raised for digging and dumping. Both booms are swung laterally. The back of the bucket is movable and in dumping it is pulled through the bucket, thus cleaning it effectually even when handling sticky material. A 40-HP. gasoline engine supplies the power for the boom lines and for the caterpillars. The latter afford a bearing surface of about 250 sq. ft. or 1 sq. ft. to each 500 lbs. of weight. Another Fairbanks walking dredge is propelled by means of inclined spuds. In a socket at the head of the boom slides a vertical timber, with a scraper bucket fitted to its lower end and operated by a cable. The Leach dry-land ditcher resembles a dredge or steam shovel mounted on a turntable carried by a single caterpillar or rolling platform.

WIRELESS FOR SUBMARINES.—The results obtained from the trials of wireless telegraphy fittings in certain submarines during last year's naval manoeuvers were generally satisfactory. All the submarines of the B, C, and D classes are accordingly to be supplied with the improved sets of instruments and fittings. Each vessel will be provided with a mast and gaff for supporting the aerial wires, and with provision for lowering the same down level with the upper deck when not in use, together with water-tight sockets in the deck for leading the aerial wire down to the instruments. Up to the present no great difficulty has been experienced in receiving messages within a radius of about 50 miles, but hitherto it has not been found possible to send messages with the same facility, and to this part of the problem wireless experts are directing their attention. A special "tune" will be used for the under-water sets of instruments, but easily adapted to the instruments of the depot or other ships acting in support of the flotillas.—London "Engineering."

*Engineering News, April 5, and Oct. 25, 1906.

The Apportionment of the Cost of Construction and Maintenance of the Massachusetts Metropolitan Sewerage, Park and Water Systems.

By J. ALBERT HOLMES.*

The main sewerage, park and water-supply systems of the Massachusetts Metropolitan District have been constructed by state commissions, but at local expense. As a rule, the State Legislature [General Court] did not presume to say how the cost of these great works should be divided between the twenty municipalities (more or less) involved. Instead, it provided, at least originally, for the appointment of special apportionment commissions, chosen once in five years, and left the division of cost almost wholly to these commissions. An account of the way these costs have been apportioned follows. Most of the space available to the writer has been given to the sewerage apportionments.

The Metropolitan Sewerage Systems.

The Metropolitan Sewerage Commission was created under an act of the Legislature in the year 1889 (Chap. 439) with authority to construct and maintain a trunk sewerage and sewage-disposal system for a district situated mostly north of the Charles River, and also another system for a smaller district south of the Charles, known as the Charles River System.

The former system, with its various extensions, is now the North Metropolitan System. Its outlet is in tide water on the north side of Boston Harbor, off Deer Island. The valuation of the district for purposes of assessment in 1910 was $486,614,003; the population, by the State Census of 1905, was 473,156.

The Act of 1895 (Chap. 406) provided for the Neponset River Valley System and that of 1899 (Chap. 424) authorized the construction of a high-level sewer, and at the same time combined these two systems and the Charles River System, with other important additions, into the South Metropolitan System. The outlet of this system is also into tide water, but on the other side of the harbor, off Nut Island. The valuation of this district for purposes of assessment in 1910 was $566,993,650; the population, 300,302.

The Sewerage Commission was the first board established in Massachusetts for the purpose of carrying on large and extensive engineering works in a metropolitan district consisting of cities and towns of many and diverse interests, dense population and small area, of great area, sparsely peopled, and of wide variation in wealth.

Sec. 13 of the original Act reads as follows:

The supreme judicial court sitting in equity shall, on the application of said board after notice to each of the cities and towns hereinbefore named, appoint three commissioners, who shall not be residents of any of the cities or towns mentioned in this act, who shall after due notice and hearing and in such manner as they shall deem just and equitable determine for each system the proportion in which each of the cities and towns hereinbefore named shall annually pay money into the treasury of the commonwealth for the term of five years next following the year of the first issue of said scrip or certificates, to meet the interest and sinking fund requirements for each of said years as estimated by said treasurer, and to meet the cost of maintenance and operation of said system for each of said years, as estimated by the said board and certified to said treasurer, and any deficiency in the amount previously paid in, as found by said treasurer, and shall return their award in said court; and when said award shall have been accepted by said court the same shall be a final and conclusive adjudication of all matters herein referred to said commissioners and shall be binding on all parties.

Sec. 14 provides that before the expiration of the first five years and every five years thereafter other apportionment commissioners shall be appointed in the same manner to determine as they deem just and equitable, the proportion each city and town shall pay annually during the next succeeding term of five years.

By Sec. 12 the state treasurer is required to issue scrip or certificates of debt in the name of the commonwealth, as registered bonds, not to exceed a certain amount and to mature in 40 years, the interest thereon not to exceed 4% per annum.

Upon making an issue of bonds the state treasurer is required to establish a sinking fund and apportion thereto, from year to year, an amount sufficient, with its accumulations, to extinguish the debt at maturity.

That these payments may be more nearly in proportion to the greater use of the sewers by the increasing population, the assessment of this apportionment for interest and sinking fund is to be at the rate of one-eightieth part of the whole amount in each of the first ten years, one-sixtieth part in each of the second ten years, one-thirtieth part in each of the third ten years and the remainder equally divided in the last ten years. Premiums received in the sale of bonds are to be applied to the payment of interest on the loan.

Sec. 15 provides that the money required of each city and town to pay the interest, sinking fund requirements and cost, also any deficiency, shall be made a part of the state tax and paid with and as a part of said annual state tax. Some of the later appropriations were made a part of the original loan, they to mature at the same time, namely, 1930, the annual assessment for sinking fund and interest charges being increased during the first period of ten years, that for the other three periods remaining the same.

The foregoing notes outline the process by which an apportionment may be determined. The working of the scheme is as follows. The Sewerage Commission estimates the cost of maintenance and operation for each year of a five-year period and certify the same to the state treasurer. The treasurer determines the annual amount required for interest and sinking fund purposes for the period, to which he adds any deficiency. It is then the duty of the apportionment commission, appointed according to the act, that is by the Supreme Judicial Court, sitting in equity, to determine the proportions in which the respective amounts shall be paid in by the several cities and towns.

Under Sec. 13 of the original act the first apportionment commission was appointed in 1891. It consisted of the following eminent lawyers: Ebenezer R. Hoar, of Concord, William C. Endicott, of Salem, and John E. Sanford, of Taunton.*

After numerous hearings, extensive investigations and with the assistance of several rulings by the court, the commission arrived at a decision and made an award which was returned Nov. 12, 1891; and issued by the court Jan. 20, 1892. The basis of the award, which covered the years 1891 to 1895 inclusive, is best described in the words of the commissioners:

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*The members of each of the subsequent commissions were lawyers. Mr. Sanford served on the second as well as the first commission.

We have come to the conclusion that there is, upon the whole, no method more just and equitable than to apportion the payments on account of the interest and sinking fund requirements of the loan, which represents the first cost of the system, with primary reference to the total taxable valuations of the several cities and towns; and the payments on account of the cost of maintenance and operation, with primary reference to their respective populations; making, however, in both cases such deductions or allowances in favor of any city or town as upon the facts justice and equity may seem to require; thus, for example, the valuation and population of areas which are physically so situated that they cannot be drained into the system have been excluded in favor of the cities and towns within whose limits such areas lie. * * * The valuations of May 1, 1890, and the national census of that year, have been used for the purposes aforesaid.

To the total values of real and personal estate as assessed by the local boards have been added the values as furnished to us by the tax commissioners of all bank and corporation stocks and ships and vessels, the taxes on which are paid or accrue under State laws to the several cities and towns.

The act providing for the Neponset Valley System (Chap. 406, of the year 1895) states (Sec. 16) that the commissioners may consider

the amount of the use of the sewers by said city or towns; * * * also the extent, if any, to which said main sewers relieve the city or towns of the necessity of constructing local sewers, * * * and any other considerations as may seem to them just and equitable.

The commissioners considered this language as suggestive rather than obligatory. An almost endless number of methods have been presented to the various commissions, but each successive apportionment commission has used the same basis; namely, valuation and population. This has doubtless been largely due to the high legal standing of the members of the first apportionment commission.

The second commission, making the apportionments in 1895-96, had this to say regarding the basis used:

We have been unable to find, upon the whole, any better measure of the ability and duty to contribute to the cost of public works of this character than the taxable valuation of the several cities and towns which comprise the districts for whose common welfare these systems were created, or any better measure of the use enjoyed and the benefits received by the several municipalities than the number of persons who dwell within their respective limits.

Under our laws, no facts are more carefully ascertained than the taxable value of real and personal property, and the resident population, in the several cities and towns.

The third commission commented as follows on the basis adopted by it.

There does not seem, on the whole, to be any fairer method of assessing the cost of construction of great public undertakings of this kind than that of assessing such cost on the various cities and towns according to their taxable valuation.

On the other hand, it is undoubtedly true that after construction the use made of the sewerage system by each city and town depends upon the number of inhabitants; and as the cost of maintenance and operation is directly proportional to the amount of sewage discharged, it would seem that the basis of population would be a just and equitable method of assessing such expense.

A fourth commission stated in 1901:

We have been urged by the representatives of several municipalities to adopt a different method of distribution than that followed by the commissioners who have previously made the apportionment; but the weight of opinion expressed at the hearings was very clearly in favor of continuing the methods hitherto adopted, and, in our judgment, particularly in view of precedent, the weight of argument demands such course.

We are satisfied that the plan adopted accomplishes substantial justice in distribution of the burden in accordance with benefits received.

The fifth commission, reporting in 1905, cited the fact that the four previous reports were accepted by the court and the basis of apportionment approved, and acquiesced in by a large majority of the cities and towns, and for this reason the precedent thus established should not be departed from except for the strongest reasons. This commission, therefore, adopted the same basis of apportionment as had the four previous ones.

In view of the fact that five successive commissions had used the same basis of apportionment, the Metropolitan Water and Sewerage Board (successor to the Metropolitan Sewerage Commission) suggested that sufficient precedent had thereby been established to warrant the enactment of a law embodying this principle. This was done in the acts of 1906 (Chap. 369), incidentally saving the rather large expense of the apportionment commissions.

The cost of each system has been kept separate, as was required by Sec. 8 of the original act. The North Metropolitan System has cost over six million dollars; most of the loans mature Jan. 1, 1930, and on all but a few the interest is at the rate of 3%.

The South Metropolitan System has cost nearly nine million dollars; the loans mature at various times between 1930 and 1947, and the interest is at the rate of 3 and 3½%. No loans are for more than 40 years.

Table I. gives the percentages, as fixed by the various apportionment commissions, and also under the act of 1906. Table II. compares (for the South District) the percentages actually used for apportioning first costs from 1906-10, inclusive, with the percentage which the population of each community is to the total population of the district, and also gives the corresponding totals for the five years, and the ratio of the assessment basis to the population basis totals.

Newton and Brookline made strenuous objections to the acceptance of the award made by the first commission, and before a later commission Brookline and Milton objected to the apportionment based on valuation to pay construction costs, but did not object to the basis of population for cost of maintenance. These towns are wealthy residential towns, the assessed valuation is large in proportion to the area, and the area is thinly populated.

The fear of Newton and Brookline that they would be obliged to pay large proportions on the basis of valuation was realized, as may be seen by Table I., under the years 1900-04 and later. The table also shows how their proportion for maintenance was reduced at the same time from that of previous years—however, it is a smaller proportion of a larger amount.

Milton's proportion of 45.07 of the cost of the Neponset Valley System did not represent a large sum of money. The proportion was reduced upon the establishment of the larger South Metropolitan System; but the result was the same as in the case of Newton and Brookline.

Some readers may be interested to know that the population served by the sewerage districts is about equally distributed between separate and combined sewerage systems.

The Metropolitan Park System.

The Metropolitan Park Commission was established by Chapter 407, Acts of 1893. The same provisions were made for the appointment of apportionment commissions as was made in the Metropolitan Sewerage Act.

The award of the first apportionment commission, based on valuation and population, with allowance for special benefits, was confirmed by the court but set aside by the legislature.

The second commission adopted valuation as the basis, allowed for local parks already constructed, and modified this by a valuation per capita. This per capita valuation was divided into three classes and 25% taken from the lowest and added to the highest class.

Valuation was adopted as a basis by the third commission. The fourth commission, whose award has not yet been confirmed by the court, determined that for Parks 60% shall be apportioned according to valuation, 25% according to valuation, excluding eight towns, and 15% according to population, excluding the same eight towns. For Boulevards, one-half is paid by the State, according to the Boulevard Act. Of the remainder, one-fourth shall be paid by the cities and towns having boulevards within their limits in proportion to the total mileage and three-fourths by the district on a valuation basis.

For the Nantasket Beach Reservation the apportionment is based on valuation. For the Charles River Dam and Basin, after deducting sums for special benefits and for various works specified in the acts, the remainder is apportioned on a basis of valuation.

The Metropolitan Water System.

The Metropolitan Water Board was established by Chapter 488, Acts of 1895. The act

TABLE I.—PERCENTAGE DISTRIBUTION OF FIRST AND OF MAINTENANCE COSTS OF THE MASSACHUSETTS METROPOLITAN SEWERAGE COMMISSION, BY COMMUNITIES IN THE VARIOUS DISTRICTS AND BY YEARS, 1891 TO 1910.

	North Metropolitan Sewerage System.											
	Interest and sinking fund requirements based on valuation.						Maintenance and operation, based on population.					
City or Town.	1895-1901-	1900-1896-		1905-1901-	1908-1906-	1909.	1912-1910-	1891-1895.	1896-1900.		1901-1905.	1906-1908.	1909-1910.
Arlington	2.08	2.36	...	2.39	2.37	2.42	2.47	1.25	1.79	...	2.06	2.05	2.04
Belmont	1.30	1.12	...	1.50	1.44	1.40	1.41	.46	.78	...	.94	.92	.92
Boston	*20.83	*20.08	...	16.89	16.44	16.20	15.63	22.65	22.82	...	20.66	19.32	19.30
Cambridge	23.69	22.60	...	25.75	25.46	24.57	23.45	26.39	22.47	...	21.96	20.62	20.59
Chelsea	7.19	6.36	...	6.20	5.67	5.83	5.24	10.52	8.61	...	8.14	7.89	7.88
Everett	2.64	3.46	...	4.81	4.88	5.18	5.62	4.14	5.11	...	5.82	6.16	6.15
Lexington	...	...	...	.90	.92	.87	.98	...	...	...	.32	.68	.79
Malden	6.35	7.07	...	8.16	7.60	8.13	9.25	8.68	8.18	...	8.05	8.05	8.04
Medford	4.20	4.56	...	5.40	5.09	5.04	4.99	2.46	3.98	...	4.36	4.16	4.16
Melrose	2.25	2.78	...	3.41	3.64	3.58	3.51	1.86	3.24	...	3.10	3.02	3.02
Revere	...	...	...	...	2.75	2.87	3.22	...	...	...	...	2.68	2.68
Somerville	10.91	12.36	...	13.87	13.50	13.62	13.44	15.14	14.37	...	14.74	14.66	14.64
Stoneham	1.13	1.10	...	1.35	1.19	1.10	1.06	1.36	1.73	...	1.48	1.34	1.34
Wakefield	...	.24	...	2.35	1.93	1.94	1.90	...	.18	...	1.78	2.17	2.17
Winchester	1.69	1.90	...	2.41	2.50	2.70	2.84	1.08	1.64	...	1.73	1.74	1.74
Winthrop	1.12	1.29	...	1.81	2.00	2.16	2.51	1.02	1.15	...	1.45	1.49	1.49
Woburn	3.07	2.72	...	2.80	2.62	2.39	2.39	2.99	3.90	...	3.41	3.05	3.05
Total	...	...	...	100.00	100.00	100.00	100.00	100.00	100.00	...	100.00	100.00	100.00

	Charles River System.		Neponset Valley System.	South Metropolitan System.			Charles River System.		Neponset Valley System.	South Metropolitan System.		
			1896-1900.	1900-04.	1905-09.	1910-12.			1896-1900.	1900-04.	1905-09.	1910.
Boston	...	...	23.28	42.42	39.98	41.30	25.05	26.41	28.14	43.30	46.52	48.32
Brookline	5.15	4.55	...	19.23	21.73	20.90	14.16	16.24	...	7.86	7.73	7.80
Dedham	...	...	13.52	2.13	2.33	2.42	...	...	19.85	3.02	2.84	2.59
Hyde Park	...	...	18.13	2.52	2.64	2.65	...	...	35.51	5.75	5.14	4.83
Milton	...	...	45.07	5.75	5.40	5.30	...	...	16.50	2.68	2.55	2.35
Newton	4.02	3.47	...	15.30	15.16	14.26	29.35	28.00	...	13.41	13.03	12.26
Quincy	...	...	...	4.91	5.07	5.40	...	...	...	10.06	9.27	9.35
Waltham	1.59	1.37	...	5.08	4.95	5.04	22.82	21.38	...	10.14	9.11	8.75
Watertown	.79	.61	...	2.66	2.74	2.73	8.62	7.97	...	3.78	3.76	3.75
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*Both systems.

TABLE II. COMPARISON OF DISTRIBUTION OF INTEREST AND SINKING FUND CHARGES BETWEEN THE COMMUNITIES COMPOSING THE SOUTH METROPOLITAN SEWERAGE DISTRICT (MASSACHUSETTS) UNDER THE ASSESSED VALUATION AND THE POPULATION BASIS, FOR THE FIVE YEARS, 1906 to 1910, INCLUSIVE.

	Percentages payable under each plan.				Total payments 1906-10, 1 = 1,000.		Ratio assessment & population.
	1906-09.	1910.	1906-9.	1910.			
	Assessed valuation.		Population.		Assessed valuation.	Population.	
Boston	39.98	41.30	46.52	48.32	$724	$843	0.86
Brookline	21.73	20.90	7.73	7.80	388	139	2.79
Dedham	2.33	2.42	2.89	2.59	42	51	0.82
Hyde Park	2.64	2.65	5.14	4.83	47	91	0.52
Milton	5.40	5.30	2.55	2.35	97	45	2.16
Newton	15.16	14.26	13.03	12.26	269	231	1.16
Quincy	5.07	5.40	9.27	9.35	92	167	0.55
Waltham	4.95	5.04	9.11	8.75	89	162	0.55
Watertown	2.74	2.73	3.76	3.75	49	68	0.72
Total	100.00	100.00	100.00	100.00	$1,797	$1,797	1.00

The distribution was actually based on assessed valuations. New assessment figures were used in 1910, but the population figures were taken from the State Census of 1905.

provided that valuation and population should be the basis of apportionment of interest and sinking fund charges and cost of maintenance and operation; consumption of water was substituted for population in 1907.

Boston's share of the assessment is based on the proportion its valuation bears to the total valuation of the district, though if there be a city or town in the district that is obtaining water from its own sources or has not applied to the board for water, only one-sixth of the valuation of such city or town is included in the total valuation.

The remainder of the assessment is apportioned to the cities and towns of the district, except Boston, basing one-third on their valuation and two-thirds on their population (water consumption substituted in 1907).

Only one-sixth of the valuation and one-sixth of the population (consumption since 1907) of a city or town that is obtaining water from its own sources or has not applied to the board for water, is included in the total; but if a city or town is assessed on its full valuation and population, and is obtaining water from its own sources, $12 per 1,000,000 gals. so obtained is credited.

The act stipulated that no apportionment should be made until the year 1898, and then for but $300,000 plus preliminary expenses, the annual increment thereafter to be $200,000 until the annual amount required for the payment of interest and sinking fund charges and cost of maintenance and operation was reached. Assessments are to be paid as a part of the State tax.

Some Observations on the Attack of Poles by Woodpeckers.*

By HOWARD F. WEISS.†

There is scarcely a highway in the United States of any importance which is not paralleled by a line of poles, the total number in use approximating 32,000,000. An examination of such poles will frequently reveal that they contain one or more holes bored into them by woodpeckers at various points from the ground. In 1906, the author made a count in Louisiana of a number of telephone poles attacked in this manner. Out of 268, 110 poles or 41% had been bored into. In southern Indiana another examination was made of two pole lines near Greenwood. In one, which extended north, out of 89 poles it was found that 21% had been attacked and in the other, which ran south, out of 58 poles only 59% were uninjured. These observations suggested an investigation into the possible damage to poles by woodpeckers and led to the preparation of this paper.

By engineers, it has frequently been held that woodpeckers are a pest. The birds have been shot and hanged by placing a noose of horse hair around the entrance to their holes so that they would become entangled in it. The author knows of an owner who attemtped to protect his poles by filling the woodpecker holes with pebbles. This method, however, did not succeed as the birds bored holes at other points. In fact, they seemed rather to enjoy the rattle of the pebbles and, if anything, bored more holes into the poles.

Creosoting, apparently, does not keep off the birds. The Cumberland Telephone Co. states that it has several thousand creosoted telephone poles in use and that these are attacked by woodpeckers notwithstanding the presence of creosote, a great number of its poles being thus damaged. In making an inspection of a pole line near Dover, N. J., the author noticed a pine pole which had been uniformly impregnated with creosote, 12 lbs. per cu. ft., and which had a hole 2 ins. in diameter and about 5 ft. from the top bored into it by a woodpecker. Some observations by the Norfolk Creosoting Co. have shown that if a pole is improperly treated with creosote so that there are streaks or sectors of untreated wood along its length, such points are very liable to be attacked by birds which will at times establish their nests in them.

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The woodpeckers which are most injurious are the ant-eating woodpecker (*Molanerpes formicivorus*), the gold-fronted woodpecker (*Conturus aurifrons*), and the redheaded woodpecker (*Molanerpes anthrocephalus*), this latter species being the one common in our northern states. The poles are attacked by the birds chiefly for the insects contained in them, or for nesting sites. In some cases, however, particularly with the ant-eating woodpecker, they are used as a store house for food. This bird will frequently fly for miles with an acorn in its bill, drill a hole in a pole and insert the acorn into it, to be used when it gets hungry.

Woodpeckers usually attack the pole near its top, although at times they may bore within a few feet of the ground. Some observations which the writer made on a telegraph line paralleling a railroad in Tennessee, showed that those poles which were embedded in hilltops above the level of the track, were the ones most seriously attacked, which those which were in valleys so that their tops were not higher than the level of the track were seldom, if ever, attacked. This may have been due to the noise from the passing trains frightening the birds, except when they were at work at the higher elevations, or to their preference for enjoying a broad outlook over the surrounding country.

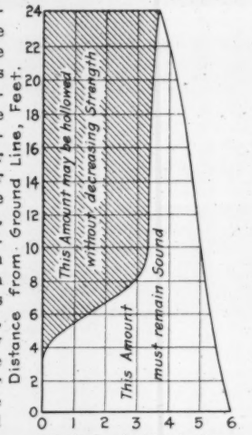

Distance from Ground Line, Feet.
Radius of Pole, Inches.
This Amount may be hollowed without decreasing Strength
This Amount must remain Sound

Diagram Showing the Extent to Which a Pole Can Be Hollowed by Birds Without Appreciably Decreasing Its Strength.

The number of holes in each pole may vary from one to a dozen or more, although these larger numbers are not common. The size of the hole varies from about ½ to 3 ins. diameter. When used for nesting sites, the birds may hollow out a pocket 6 to 10 ins. in diameter and a foot or more in depth.

The question of interest to telephone engineers is to just what extent are such poles weakened. The following example may be of interest. It has been found from measurements on 250, 30-foot Northern white-cedar poles that their average taper is approximately as follows:

Circumference (ins.)	Distance from butt (ft.)
43	0
37	5
36	6
34	10
32	15
29	20
27	25
24	30

Assuming the pole as a cantilever, loaded at one end, it is found that it may be hollowed to the extent shown in the figure without decreasing its strength. The length of ordinate between shaded area and right-hand edge of the diagram, represents the thickness of outer shell which must be sound. For example, at 10 feet from the ground if only 2 inches of the outer shell are left, the pole will be approximately as strong as though it were solid. This grants the bird permission to build a house about 6 inches in diameter. The higher up the pole it goes the larger can be its nest without injury. If, however, the attack is less than four feet from the ground the pole will be appreciably weakened.

This illustration neglects the damage done by the entrance into the pole, or the subsequent decay which may follow, and assumes that the bird builds its nest exactly in the center; a condition not always found in fact. On the other hand, it assumes that the pole has a uniform moisture per cent. throughout its length and that the outer fibers at the ground line are perfectly sound. These conditions seldom, if ever, exist in practice, as the pole, particularly if it has been set for a year or more, always contains more moisture near the ground than at any point above it, and the sapwood at the ground is invariably more or less decayed. Hence, the birds could peck even larger holes than those shown in the sketch without increasing their damage.

The engineering department of the American Telephone and Telegraph Company made a few tests in 1908 near Zanesville, Ohio, to determine the effect of woodpecker attacks upon the strength of poles. These tests were made by fastening a rope around the top of the pole and pulling with a block and tackle to which a dynamometer was attached. In nine cases out of twelve the poles broke at the ground line and not at the points attacked by the birds. The examples in the accompanying table are typical.

TYPICAL RESULTS OF TESTS OF DAMAGED POLES. AMERICAN TELEPHONE & TELEGRAPH CO. ZANESVILLE, OHIO.

Pole number	6,390	6,325	6,372
Material	Cedar	Cedar	Cedar
Wires	44	44	44
Length	35 ft.	35 ft.	35 ft.
Circumference, at ground (original)	43½ ins.	42½ ins.	40½ ins.
Circumference, below ground (minimum)	38½ ins.	42 ins.	38 ins.
Circumference, point of load	31 ins.	31½ ins.	27 ins.
Diameter, bird hole	6 ins.	8 ins.	See note
Distance of hole above ground	9 ft. 6 ins.	24 ft.	....
Distance of load point above ground	25 ft.	26 ft.	....
Broke off at	ground	....	ground
Under corrected load	520 lbs.	....	1,100 lbs.
Set in	earth	rock	earth
Top deflection (max.)	2 ft. 11 ins.	5 ft. 7 ins.	....
Butt deflection (max.)	1 ft. 3 ins.	5 ins.	....
Est. breaking weight	1,200 lbs.	3,000 lbs.	2,600 lbs.

After Pole No. 6390 broke as above shown it was reset and tested as a 30-ft. pole and it broke at the new ground line (40½-in. circumference) under 1,000 lbs. corrected load. It had a 2½-in. shell at break. Estimated breaking weight as a 30-ft. pole, 2,500 lbs.

Pole No. 6325 was sound at the ground and set in wet rock hole with about 10 ins. of clay on top. At 3,000 lbs., actual reading, the dynamometer slipped. The load was applied for 300 lbs. more when the rope broke and test was abandoned.

Pole No. 6372, at 1,100 lbs., corrected load, gave way at ground, but did not quite break off. There were ten woodpecker holes between 15 and 20 ft. above ground as follows:

13 ft. above ground.....3 × 3 ins., 4 ins. deep
17 ft. above ground.....3 × 3 ins., 5 ins. deep
18 ft. above ground.....3 × 3 ins., 3 ins. deep
19 ft. above ground.....3 × 3 ins., 5 ins. deep
At 5th gain, 30-in. circum., 6 smaller holes.

It appears, therefore, that the attack of poles by these birds is not as serious as one would be prone to believe and, taking into account the great good that they do in eating insects, the destruction of our feathered friends can by no means be justified by the injury they do to pole-line construction.

RAILWAY ACCIDENT BULLETIN NO. 37, issued by the Interstate Commerce Commission, gives statistics of accidents on steam and electric railways in the United States during July, August and September, 1910. This bulletin is the first to be issued under the revised accident law. It differs, therefore, from those previously issued, in that it includes several classes of accidents not formerly given, such as grade-crossing accidents and accidents to trespassers. On the other hand, a separate class of "industrial accidents" has been made which includes a large part of the accidents to employees. This new class covers those injuries to men in freight houses or railway shops which are not peculiar to railway operation, and accidents to men engaged in outdoor work where no cars or engines are involved.

The number of persons killed during the quarter on steam roads in accidents of all kinds, except "industrial accidents," totals to 2,948, while 19,380 were injured. In train accidents, 321 persons were killed and 3,892 injured; in falling from and getting on or off cars or engines, 470 persons were killed and 4,882 injured; in being struck or run over by engine or car, 1,926 were killed and 2,036 injured. These three general classes of accidents were responsible for more than 90% of the total number of fatalities.

Highway grade-crossing accidents caused 313 deaths and the less serious injury of 646 other persons.

Of the total number of persons killed, 1,707, or nearly 58%, were trespassers, of whom more than half were struck or run over by trains.

Electric railways carrying interstate traffic are the only electric lines of which statistics are given. On such lines, 146 persons were killed and 1,070 injured during the quarter in all accidents other than "industrial accidents." In train accidents, 46 persons were killed and 468 injured.

The Grain Elevator of the Grand Trunk Pacific Ry. at Fort William (Ont.), Canada.

The largest grain handling and grain storage plant in the world is that which is now being built for the Grand Trunk Pacific Ry. at Fort William (Ont.), Canada, to serve the enormous and increasing traffic due to the development of the wheat growing districts of western and northwestern Canada. It is estimated that in a few years the annual wheat crop of this district will reach 700,000,000 bushels, while in the present state of development the maximum has reached 120,000,000 bushels. When the Fort William plant is completed it will have a storage capacity of 40,000,000 bushels, but it will be built in four separate units for 10,000,000 bushels each. The first section, which was completed in December, 1910, has a storage capacity of 3,500,000 bushels, with equipment for handling and cleaning. The cost of this section was about $1,250,000.

Preliminary plans for the plant were prepared by the engineers of the railway during 1906-1907. In 1908, a contract was awarded to the Canadian Stewart Co., of Montreal, for the construction of the first section (3,500,000 bushels capacity) according to plans and specifications submitted by that company. The work was commenced in November, 1908. The designing was under the direction of Mr. R. H. Folwell, Chief Engineer; the construction was done under Mr. W. R. Sinks, General Manager, both of the contracting company. Mr. John S. Metcalf was Resident Engineer for the owners. The plant will be operated by a subsidiary company known as the Grand Trunk Pacific Elevator Co., of Winnipeg, Canada. Fig. 1 is a view of the shipping side or water front of the elevator. Figs. 3, 4 and 5 show the general construction and arrangement.

The elevator was built on reclaimed land on the delta formed near Lake Superior by the Kaministiquia and Mission rivers. It is founded on 55-ft. timber piles driven to rock. A heavy concrete mattress and walls distribute the load evenly over this footing. A concrete wharf 337 ft. long and 12 ft. wide forms the water front, and there is a sufficient depth of water here for the largest lake carriers. The fact that grain can be delivered directly into vessels is a factor of great importance in relation to the efficiency of this type of elevator. In the case of terminal elevators at the seaboard (for ocean-going steamers) long conveyor galleries are usually necessary for the distribution of grain from the elevators, as the vessels carry a miscellaneous cargo and must lie at warehouse wharfs in order to receive all classes of freight simultaneously. With the grain elevators on the upper lakes this condition is obviated, since grain generally forms the entire cargo of a steamer, and thus dock spouts (delivering directly to the vessels through

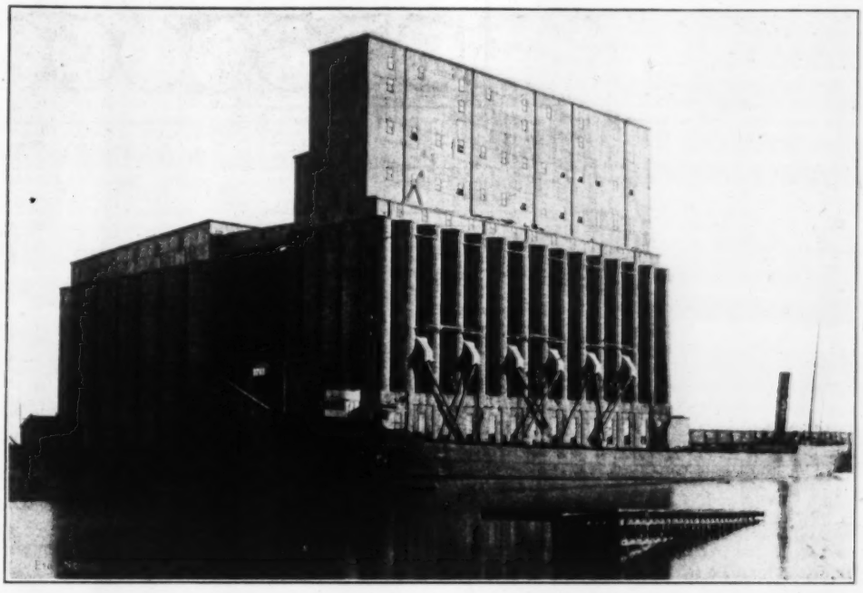


FIG. 1. SHIPPING SIDE OF THE GRAND TRUNK PACIFIC ELEVATOR AT FORT WILLIAM (ONT.), CANADA. CAPACITY, 3,500,000 BUSHELS.
(The Canadian Stewart Co., Montreal; Contractors.)

FIG. 2, CONSTRUCTION OF THE CONCRETE BINS FOR THE GRAIN ELEVATOR.

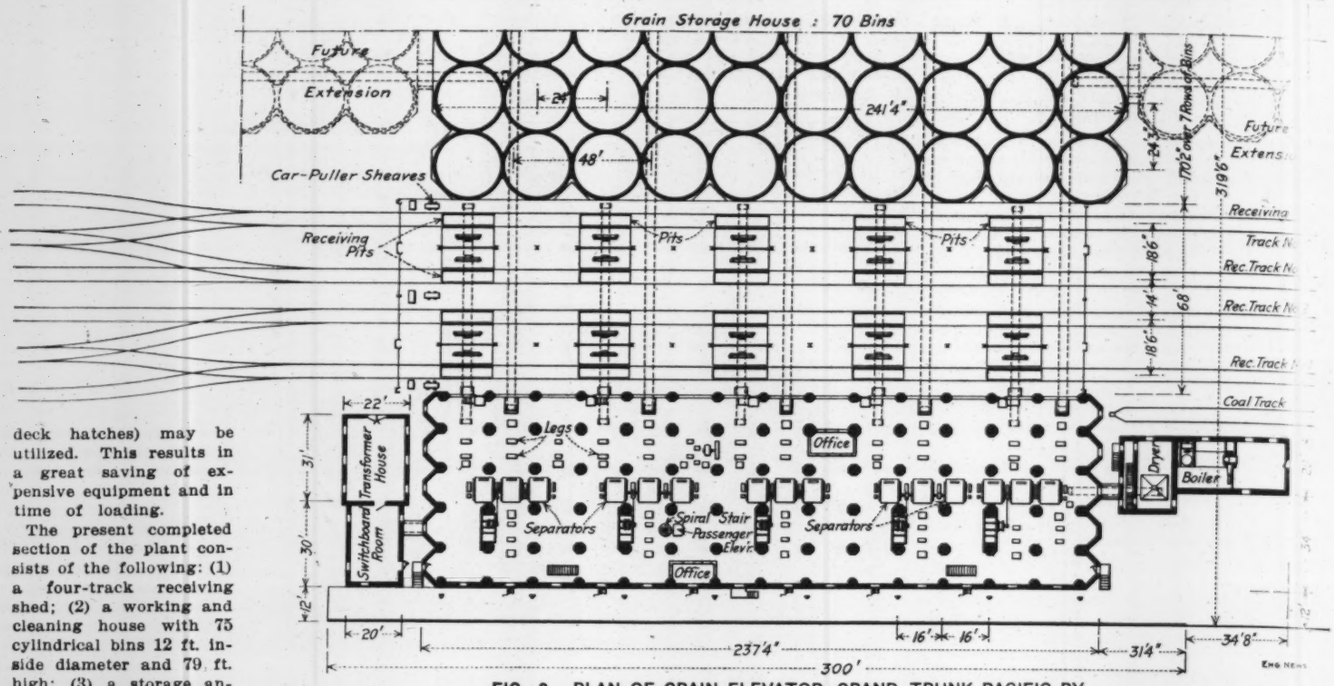


FIG. 3. PLAN OF GRAIN ELEVATOR, GRAND TRUNK PACIFIC RY.

deck hatches) may be utilized. This results in a great saving of expensive equipment and in time of loading.

The present completed section of the plant consists of the following: (1) a four-track receiving shed; (2) a working and cleaning house with 75 cylindrical bins 12 ft. inside diameter and 79 ft. high; (3) a storage annex of 2,750,000 bushels capacity, having 70 bins 23 ft. 3 ins. inside diameter and 95 ft. high; (4) a house for the electrical transformers and switchboard; (5) a drying plant. In both the working house and the storage annex the spaces between the main bins are used also for storage. The smaller buildings and the main structures from the bottom of foundation to the top of the bins are built of reinforced concrete. The cupolas of the working house and storage annex are of steel frame construction, with concrete roofs and floors, the roofs having a five-ply felt and composition covering. The doors are steel-covered, and sheet metal window frames glazed with ¼-in. ribbed wire glass are used throughout.

The forms for the cylindrical bins are of particular interest. They consist essentially of inner and outer wall staves 4 ft. high, held in place by built-up wooden rings. To maintain the proper space between these walls rigid yokes built of steel plates and channels are bolted to the forms. The latter are raised continuously as the work progresses and give a smooth surface without unsightly rings, breaks, or offsets. Another advantage in the use of these forms is that when the work is completed they may be taken down and used a second time. The construction of the yokes and jacks for the forms is shown in Fig. 6.

These circular forms were handled and raised by means of an ingenious device invented by Mr. R. H. Folwell and Mr. W. R. Sinks, of the contracting company (mentioned above). This is patented in both the United States and Canada. The essential element in the invention is a hollow jack screw (Fig. 6) through which is passed one of the vertical rods for reinforcing the concrete; the jack is made to climb this rod, and thereby raise the forms. In operation, a bar is inserted in one of the sockets in the cast head of the jack, and with this leverage the screw is turned. By turning to the right, the forms are lifted, and by turning to the left the jack itself climbs the rod, while the form remains stationary, supported by the adjacent jacks.* By reason of the rod passing through the jack, the load is applied concentrically, and thus any tendency of the forms to bind is eliminated. No delay is caused by the placing of additional vertical rods as these are merely inserted in the tops of the jacks. In this way, daily progress may be observed accurately by reference to marks on the rods, which will also assist in obtaining the precise location of the horizontal reinforcing rods and in keeping the forms truly level. The forms of the separate tanks, though constructed in sections, are tied together to prevent spreading from the pressure of wet cement by a system of horizontal rods attached from yoke to yoke. They serve to support the working floor.

*A different device for the same purpose was illustrated and described in our issue of Dec. 2, 1909.

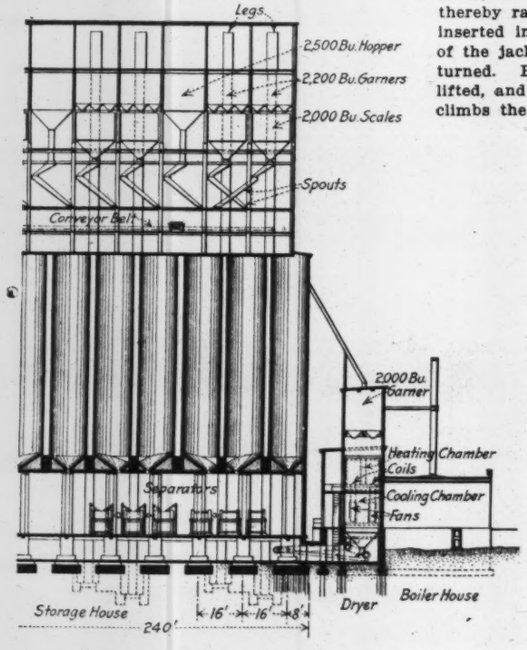


FIG. 4. PART LONGITUDINAL SECTION.

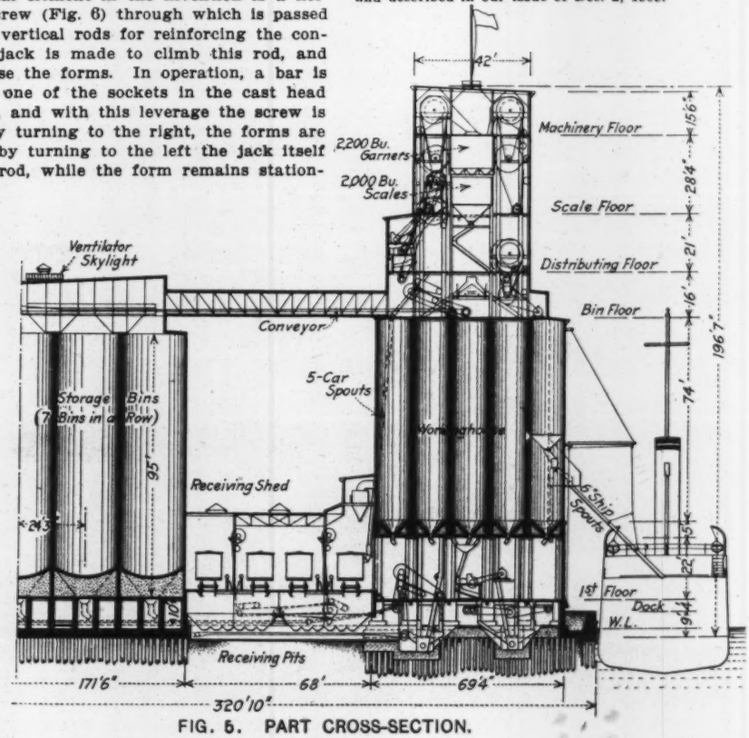


FIG. 5. PART CROSS-SECTION.

The concrete was composed of Portland cement, sand and gravel, in the proportions of 1:2:4, mixed very wet. The aggregate varied in size from 2½ ins. down to coarse sand. The various materials were handled by steel dump cars hauled by locomotives. The sand and

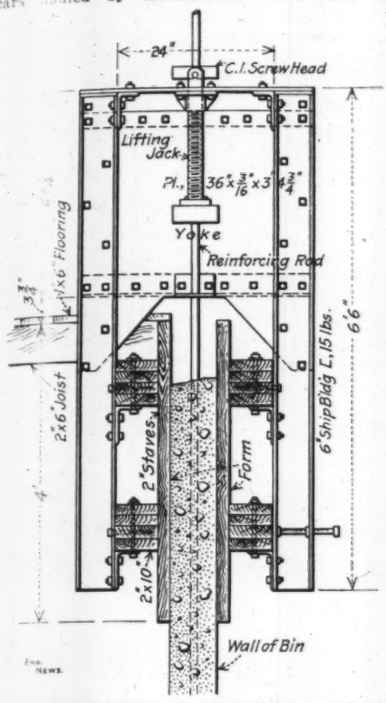


Fig. 6. Jack and Yoke for Supporting and Raising the Forms for the Circular Concrete Bins.
(R. H. Folwell and W. R. Sinks, Inventors.)

gravel was dredged from Lake Superior by means of derrick scows with clam-shell buckets, and unloaded upon a temporary dock 2,000 ft. long constructed for the purpose. From the stock piles the materials were loaded into the cars by a locomotive revolving crane. There were two concrete mixing plants, one at either end of the elevator, and each had two concrete mixers. Here the aggregate was elevated to charging hoppers, where cement and water were added. The proper amount for a batch of concrete was then introduced into the mixer, and from there the concrete was poured directly into a large hoisting bucket in an elevator tower. The loaded bucket was then raised and emptied into a hopper above the level of the work. As the work progressed upward the hoist towers were extended and the hoppers raised. The concrete was distributed to the various sections of the work by means of concrete carts. With this equipment as much as 800 cu. yds. of concrete were placed in one 20-hour working day, and a total of 60,000 cu. yds. were handled.

The reinforcement of the bins consisted of vertical rods and horizontal hoops of flat steel of varying widths and thicknesses. For the reinforcing of the concrete columns supporting the bins of the working house, a spiral of ½-in. steel wire forming a helix 41 ins. diameter was used, supplemented by vertical rods. Round steel rods were used for reinforcing girders and floor slabs. Fig. 2 shows the concrete construction work in progress.

Operation of the Plant.

When a train of loaded grain cars is pushed onto any one of the four receiving tracks it is stopped with the first five cars over the five receiving pits. Much of the grain pours out when the car doors are opened; the remainder is plowed out by large plows or shovels guided by men and hauled by cables on electrically operated drums. With the four tracks, 20 cars can be unloaded simultaneously, giving a receiving capacity of 500 cars per 24 hours. As soon as the five cars are empty, the train is pulled ahead five car lengths by a cable on an electric hoist or car-puller which is powerful enough to handle a 30-car train. This hoist is controlled from a position in which the operator has full view of the train.

Each track pit has a capacity of 2,000 bushels, and has a gate for delivering its contents upon a 36-in. lateral belt conveyor leading to the five receiving legs. The grain thus received may be sent to the storage bins by belt conveyors overhead or to the bins in the working house and then cleaned by machines in the first story below. Then it may be elevated again and sent to the storage bins, or it may be delivered directly to the steamers. If grain needs drying it may be delivered by spouts to the dryer plant from the working house. Grain from all storage bins is fed by gravity through hoppers upon belt conveyors which deliver it to the elevators in the working house. For reloading into the cars, there are five car spouts with forked delivery heads. For loading grain directly into vessels, there are six dock spouts, each capable of delivering 20,000 bushels per hour.

In the cupola, there are 10 hopper scales of 2,000 bushels capacity, fitted with recording devices; each is served by an overhead garner of 2,200 bushels capacity. Fans and cyclone separators are used for the removal of dust from the various departments, and this is discharged into dust bins. An efficient and well balanced system of conveyors, elevators and spouts provides for the distribution and handling of grain from one part of the plant to another. Fig. 7 shows a group of the spouts serving the storage bins.

Electric power is used throughout, and current of 22,000 volts is delivered by the 22-mile high-tension transmission line from the Kakabeka Falls hydro-electric plant of the Kaministiquia Power Co. This is transformed and reduced to 550-volt alternating current. Individual motors are used throughout, and there are in all about 37 motors aggregating 2,500 HP. Rope drives are used in preference to gearing in all cases, with the exception of the car-puller, which is equipped with heavy cast-steel gears. The lighting plant includes outdoor arc lamps for the wharf and tracks, and 800 incandescent lamps in the buildings. All wiring is laid in conduits, and all hanging lamps have flexible armored conduits and wire guards. There is a complete telephone system, in addition to speaking tubes, electric bells, and a system of red and green lamps at the receiving and shipping legs for signaling the operators. A passenger elevator is provided, and also a traveling belt elevator for the workmen. Steam for heating the dryer and the offices is supplied by a horizontal tubular boiler. For fire protection there is a complete equipment of hose and piping served by a 500-gallon pump directly connected to a 50-HP. motor.

FIG. 7. TOPS OF GRAIN STORAGE BINS, SHOWING SYSTEM OF SPOUTS.

The Air-Compressor Plant for Driving the Moodna Siphon on the New York Aqueduct.*

The hilly country through which runs the Catskill Aqueduct, for supplying New York City with water, has made necessary the boring of numerous tunnels through solid rock. The contractors on these sections have installed construction plants comprising, in many instances, equipment of the highest grade and most economical type. This is particularly true of the air compressor installations, since air power is employed in very large amounts, for running rock drills, concrete mixers, pumps, and other machines.

A compressor plant of unusual interest to engineers is that of the Mason and Hanger Co., at Firthcliffe, New York, near Cornwall-on-Hudson. This firm holds the contract for driving the Moodna siphon or pressure tunnel. Their plant consists of four tandem Corliss two-stage air compressors, each with a piston displacement of 2,450 cu. ft. of free air per minute, at 100 r. p. m., providing a total capacity of nearly 10,000 cu. ft. The steam cylinders are 20 and 34 by 30 ins. and the air cylinders 18 and 30 by 30 ins. in size. Both the high and low steam pressure cylinders are equipped with full Corliss valve gear, the knock-off cams being actuated by dash pots. The point of cut-off is automatically varied by means of a coordinating speed and pressure regulator, which is dependent on both the steam and air pressure for its action.

The air cylinders are fitted with rotary inlet valves, mechanically driven, and with automatic, air cushioned, poppet discharge valves. Large water-jacket and intercooler area secures the highest possible benefits from compressing the air in two stages.

Each of these compressors weighs about 41 tons, but as these machines are practically self-contained, they may be moved from one job to another with little difficulty and at low cost.

This compressor plant takes steam at 140 lbs. throttle pressure, from water tube boilers burning anthracite coal under forced draft. The condensing plant is of the central barometric pattern. No reasonable expense was spared to make this plant as economical as possible in operation, and some excellent records in efficiency have been secured. The four compressors are used for supplying air at 110 lbs. receiver pressure to the five shafts and nine working faces, by means of which the Moodna siphon is being driven.

THE PENNSYLVANIA GOOD ROADS EDUCATIONAL train operated by the Pennsylvania R. R. Co., in cooperation with the Pennsylvania State Highway Department, the State College of Pennsylvania and the Public Roads Office of the United States Department of Agriculture, has now been running some three weeks. Dr. J. P. Jackson, Dean of the Engineering School of State College, has charge of the tour, assisted by Messrs. J. H. Dodge and D. H. Winslow from the Office of Public Roads. The train has made from four to six stops daily. From Jan. 25 to Feb. 7, 14,900 people passed through the exhibit car. It is expected that 75,000 persons will see the exhibits during the two months in which the train is to be operated.

*Abstract from an article in "Mine and Quarry."

Over-Driven Piles, Brooklyn Fourth Avenue Subway Construction.

By S. P. BROWN,* M. Am. Soc. C. E.

Some excellent examples of over-driven and broken piles occurred in the work of Tide-Water Building Co. and Thomas B. Bryson, contractors for Section 11-A-3 of the Fourth Avenue rapid-transit subway in Brooklyn, New York City. The accompanying photographs (Fig. 3) illustrate typical cases.

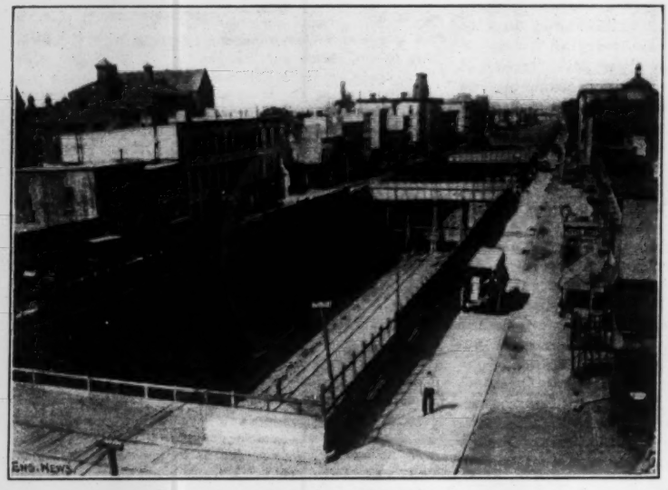


Fig. 1. Completed Excavation; Looking North from Prospect Ave.
(The outer ends of the lateral roadway platforms were supported by driven piles, later assisted by inclined shores.)

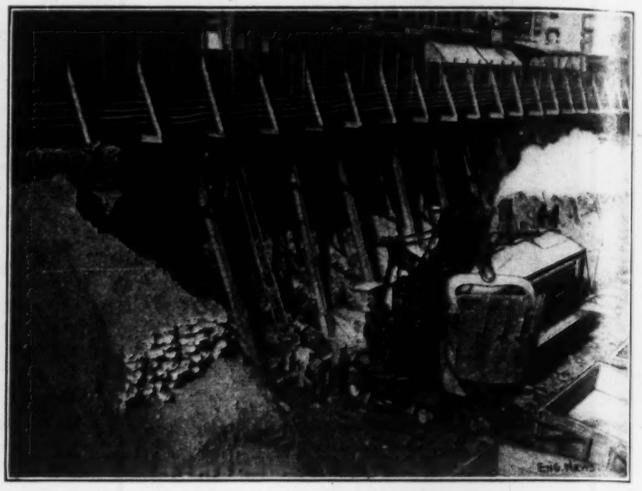


Fig 2. Excavation of Side Cut.
(Showing piles and raking braces. These piles were over-driven in many cases.)

FIGS. 1 AND 2. VIEWS SHOWING CONSTRUCTION WORK ON BROOKLYN FOURTH AVE. SUBWAY, TIDE-WATER-BRYSON CONTRACT.

The method of construction on this contract consists of (1) the removal of all subsurface structures, such as sewers, water and gas pipes, electrical conduits, etc., from the street to the sidewalks, the sewers, water pipes and electrical conduits being placed in their permanent locations; (2) Steam-shovel excavation between 12½ ft. plank roadways built along the sides of the street just outside of the line of the subway (pipe galleries have since been eliminated), the front sill resting on a longitudinal line of piles 30 ins. outside the curb and spaced about 5 to 7 ft. on centers. The front sill was designed with sufficient strength to carry its load either as a beam or a cantilever between alternate piles should the intermediate pile fail during excavation. Heavily bolted shiplap splices were used on this sill.

The steam shovel took out the excavation in

FIG. 3. FIVE EXAMPLES OF OVER-DRIVEN ROADWAY PILES.

proper, the excavation being clear of timbering between cross streets; (3) laying floor concrete, the footings for the three intermediate walls and five cuts, removing about 30% of the subway excavation and 50% of the pipe gallery excavation. When it made the final cuts close up to the roadway piles, exposing their upper portions, 10 × 10-in. raking braces were set up at 15-ft. intervals under the roadway sill, for the double purpose of carrying the roadway and counteracting any tendency for it to slide forward into the cut.

When the piles were exposed by the steam-shovel, it was found that very many of them were broken, splintered or sheared. It was known from the driving that some of them were over-driven, and from the first, therefore, it was planned to relieve them by the rakers; but the injuries proved to be more numerous than had been supposed. The undertaking to drive these piles, along a street in high, dry ground, through soil containing much sand, gravel, boulders and indurated strata, was so unusual that it was impossible to find a sub-contractor and the piles were therefore driven by the contractor's force.

The piles were principally spruce, averaging 12 ins. diameter at the butt. Yellow pine would not stand the driving. A 2,000-lb. hammer was used to drive them, and the lift ordinarily was 25 ft. Various lengths of piles from 45-ft. to 15-ft. were tried, and finally 20 ft. was selected as the most satisfactory length. The first few were driven dry, and later several forms of jet were used, the final choice being a simple goose-neck pipe jet with the usual taper point. Even with the jet, however, the driving was so hard that in most cases it was necessary to over-drive the piles to get them down. In some cases where a pile broke near the surface another was driven alongside. In some cases after a pile gave signs of breaking the driving was continued in order to pass the broken-off stub.

The bearing power of the piles was far in excess of any load ever to be imposed on them, and the only chance for trouble was in case of a pile broken in the upper part of its length where the steam shovel would expose it. Piles broken lower down were considered to be just as good as whole piles and proved to be so.

The exposed pile fractures show a variety of forms. As may be seen in the views, some are splintered and broomed, others burst and spread out, others sheared apart, with the upper end driven past the stub, etc. In many cases where the foot of the pile was reached it was found to rest on a boulder.

The method of construction worked out successfully and proved to be very fast and economical. The roadway platforms did not develop any serious shift or settlement, and there were no accidents to traffic.

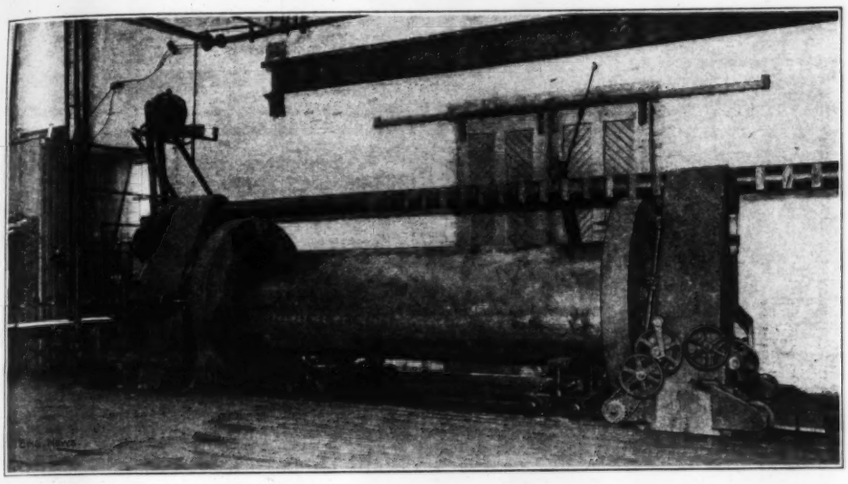
STRAITS CROSSING PROBLEMS are under discussion on opposite sides of the continent. In California the question of bridging Carquinez Straits is being agitated. A low-level bridge with draw-span was proposed some years ago but was forbidden by the Secretary of War; a high-level bridge is now being discussed. In Massachusetts there is agitation for a highway tunnel from Boston to East Boston, to supplement the present street-car tunnel. Bills are in the legislatures of California and Massachusetts on the two projects.

*Chief Engineer, Tide-Water Building Co. and Thomas B. Bryson, 641 Fourth Ave., Brooklyn, New York City.

A Large Pipe Testing Machine.

The manufacture of lap-welded pipe in large sizes (from 30-in. to 72-in. diameter) is an interesting development in pipe making. Such pipes are used for high-pressure hydraulic pipe lines, condenser and compressed-air piping, and for other purposes where severe duty is required. After welding, the pipes are annealed in large furnaces to relieve any internal stresses set up during manufacture. They are made of steel plates from ¼-in. to over 1 in. thick, the plates being of open-hearth flange steel with a tensile strength of 55,000 to 65,000 lbs. Some particulars of the pipe and of tests made as to its strength to resist bursting and crushing were given in our issue of Jan. 26 (p. 119).

A machine has been specially designed for testing this pipe at the manufacturer's shops, and is shown herewith. It will take in pipe of any diameter up to 7 ft. and any length up to 40 ft. The stationary end is in the form of a hydraulic press with a 40-in. cylinder which presses the head against the end of the pipe, and is operated from a line pressure of 750 lbs. The movable head may be shifted readily to accommodate any desired length of pipe and is securely locked in position with lock bars operated from a shaft. Although this head weighs about 8 tons, the use of roller bearings for its supporting wheels enables it to be moved with ease. Suitable packing is used to make watertight joints between the length of pipe and the heads.



HYDRAULIC TESTING MACHINE FOR PIPES UP TO 7 FT. DIAMETER AND 40 FT. LENGTH; AMERICAN SPIRAL PIPE WORKS.

R. D. Wood & Co., Philadelphia, Builders.

The pipe is first filled with water by means of a large centrifugal pump. Pressure is then applied by means of a high-pressure hydraulic pump which has a capacity of 2,500 lbs. per sq. in. The machine is capable of testing 40-in. pipe to 1,000 lbs. pressure, and other sizes in proportion to their area. A special feature of the machine is that the top bar connecting the two heads is offset from the center line a sufficient distance to enable the traveling crane to bring its hoisting chain in the center line, and thus set the pipe directly in place. Otherwise, the crane would set the pipe slightly to one side and it would have to be shifted to its exact position, thus causing delay.

The testing machine was designed by the American Spiral Pipe Co., of Chicago, makers of this lap-welded piping. It was built by R. D. Wood & Co., of Philadelphia, Pa.

TWO TRACKLESS TROLLEY LINES, according to a report in the London "Times," have been recently built in Bremen. The cars resemble motor omnibuses. Two trolley wires are used, one above another, about 8 ins. apart. The trolley, or collector, has two rollers running on the upper conductor wire and two bows on the lower. The wires from the collector to the car coil or uncoil automatically on a drum in the car so as to permit it to turn out for other vehicles.

Annual Meeting of the Connecticut Society of Civil Engineers.

For the first time in a number of years the annual meeting of the Connecticut Society of Civil Engineers was this year held away from New Haven or Hartford which have heretofore generally alternated as meeting places. The 27th annual meeting was held on February 14 and 15 at New London, and was quite largely attended by members from the western part of the state, though the absence of the larger local representation, usually brought out in the two cities where the meetings have been previously held, reduced somewhat the total attendance at the sessions. The meeting comprised a business session on the morning of the first day, a visit to the local water-works high-service pumping station and a technical meeting on the afternoon of the first day and a banquet that night. The morning of the second day was devoted to the final technical session.

It has been the custom at the annual meetings of this Society to have one or two long illustrated lectures on some great engineering work which would be of interest to the members, but not of such a nature as to admit of any prolonged or controversial discussion, and to round out the meeting with a number of shorter papers, which might be apt to provoke a general discussion. This year, however, the program was so arranged as to include a number of the lectures of the first type to the exclusion of the papers with consequent discussion. It also happens that these lectures, with only one exception, were upon subjects and works that have been thoroughly treated in Engineering News, so that our account of them must necessarily be limited. This fact does not detract at all from the interest of the lectures or the pleasure with which they were received by the members of the Society.

The two lectures of the first day were by Mr. Alfred D. Flinn, Department Engineer, Board of Water Supply of New York, on "The Catskill Water-Works for New York" and by Mr. Herbert M. Knight, formerly Engineer with the Baltimore Sewerage Commission on "Some Features of Baltimore's Ten Million Dollar Sewerage System," both of which were profusely illustrated with lantern slides.

Mr. Flinn's lecture took up first the general description of the project, now more than half completed, of bringing from the Catskill mountains north of the city of New York and west of the Hudson River, a daily supply of water eventually to total 500,000,000 gals. daily, and followed that general description with more detailed views and comments on the various structures that go to make up the system, particularly the dams, conduits, siphons and various pipe and valve details.

Mr. Knight described the initial studies made on the question of sewerage in the city of Baltimore which culminated in the vote of the city, after the big fire of 1904, to appropriate $10,000,000 to construct a complete sewerage and sewage disposal plant, from the beginning, since Baltimore up till now has been in the almost unique position of a city of more than 600,000 with no sewerage system. The work, started in the Fall of 1906, comprised the complete topographical mapping of the city, the construction of a separate system of sewers in practically every street in the city and the construction of a sewage disposal plant on Back River, an arm of the Chesapeake Bay, from which the treated effluent is to be emptied into the Bay. On account of the extensive oyster industry in the Bay it was required that the highest possible degree of purification of the effluent be reached. This disposal plant is fed through a long outflow conduit, filled from a pumping station, and consists of an initial system of hydrolytic tanks, a secondary group of sprinkling beds and a final set of settling basins. The difficulty of the work lies mainly in the construction of the sewers in the city, because of the great complications in public service and municipal underground structures already existing in the line of the streets.

The leading features of the second day's proceedings was the paper by Dr. Willis L. Moore, Chief, U. S. Weather Bureau, on "The Relation of the Weather and Forestization to Stream Flow." This was an abstract of the argument presented by Dr. Moore in his report to Congress, published in part in Engineering News, March 3, 1910, p. 245. This argument holds primarily that forests have no appreciable effect on temperature, rainfall or run-off and that, therefore, their removal can not affect the occurrence or the extent of floods. Dr. Moore has not changed or amplified his points of proof in the past year, except that he carefully avoided all reference to the flood figures of the Seine at Paris, possibly because the two recent floods there, and the consequent investigation of the floods of the 19th century, completely overthrow the previously published data, which, at the time of Dr. Moore's original report to Congress, seemed to favor his side of the argument. This is but another example of the unfortunate stage which the forest-flood controversy has reached; both sides seem to be searching for data only to confirm their own views.

Mr. R. F. Stoddard gave a short description of the Congress St. Bridge at Bridgeport, Conn. This is a reinforced-concrete highway bridge 55 ft. wide, comprising four 59-ft. skew arches and a 70-ft. single-leaf Scherzer rolling-lift draw. The main points of interest in the construction are the use of a granite protecting facing on the outside of the piers between high and low water and the use of a reinforced-concrete sidewalk slab and a wood-block roadway on the left. The granite facing was used because the engineer feared the possible wear on the inter-tidal space during freezing weather.

Prof. C. M. Allen, of Worcester Polytechnic Institute, read a paper, illustrated by numerous views entitled "Testing Water Wheels After Installation," which described in some detail the Alden brake equipment with which he has been testing a number of water-wheels in and around New England. This device is readily taken down and can be transported to any plant, set up on the shaft of the prime mover and the horsepower readily determined through any desired period.

Mr. James A. Newlands read a paper entitled "The Hypochlorite Treatment of Water," which outlined the chemical action of this process and described the several installations which have been successful in this country. A paper entitled "Actual Yield of a Typical Connecticut Watershed," by Mr. R. A. Cairns, was read by title only.

The following officers were elected for the ensuing year: Charles A. Ferry (New Haven), President; A. W. Sperry (New Haven), 1st Vice-Pres.; S. E. Minor (Greenwich), 2d Vice-Pres.. Mr. J. F. Jackson (New Haven) is Secretary and Treasurer.

The Proposed Subway System for Chicago.

The city of Chicago has been contemplating for several years the construction of a subway system, and various projects which have been put forward have been described in our columns.* The city decided definitely upon the necessity of a subway system in connection with its plans for the reconstruction and improvement of the street railway system, Mr. B. J. Arnold, M. Am. Soc. C. E., Chief Engineer of the Board of Supervising Engineers (in charge of this improvement work), was appointed Chief Subway Engineer for the city, for the purpose of preparing plans and recommendations for a comprehensive subway system. His report has been submitted recently to the mayor and to the local transportation committee of the city council.

The project as recommended by Mr. Arnold provides for separate subways for elevated railway trains and for street cars, with through connections between the north and south sides of the city and loops for the west side lines. That is to say, cars from the north side will run through the business district and into the south side of the city (and vice versa), while west side cars will pass around extended loops and return to the same line by which they entered. A sketch plan of the proposed system is shown in Fig. 1, and may be described briefly as follows:

Subways for Street Cars.—Two lines will connect the north side and south side system: (1) from the La Salle St. tunnel (A) under LaSalle and Clark Sts. to Archer Ave. (B); (2) from Chicago Ave. (C) under State St. to 12th St. (D). One loop will serve all west side lines using the Van Buren St. and Washington St. tunnels (E) and (F). Thus cars from each tunnel will pass around the loop (G-H) and return through the same tunnel.

Subways for Elevated Trains.—A single north and south subway under State St. from Chicago Ave. (J) to 12th St. (K) will connect the Northwestern and the South-Side elevated railways. Each of the two west side elevated railways will have its own loop. That of the Metropolitan Elevated Ry. (L-M) will cover Peoria and Harrison Sts., Michigan Ave. and Jackson Boulevard; that of the Chicago & Oak Park Elevated Ry. (N-O) would cover Sangamon, Madison, Michigan and Randolph Sts.

The grades are so arranged as to avoid all grade crossings, and the stations are so located in the business district as to provide for easy transfer between the different routes. To illustrate the routing of the cars we have prepared the diagram plan, Fig. 2, which shows also the relative locations and levels of the subway system. Fig. 3 shows one of the stations and intersections, with one subway depressed to pass under the other. The design is complicated by the existence of the network of single-track tunnels for the narrow-gage freight railway system of the Illinois Tunnel Co. These are generally 33 ft. below the street surface.

An alternative subway system for street cars only may be built independently of the plan above described, and could afterwards be connected with the latter. This would be as indicated in Fig. 1; (1) from the LaSalle St. tunnel at (P), under LaSalle, Lake, Dearborn and Polk Sts. to 14th St. (Q); (2) from the present west side tunnels along Van Buren, Michigan and Washington Sts., so that cars entering by one tunnel would leave by the other tunnel. This loop would be as shown by (E, R, S, F). For future developments west side extensions are projected on Chicago Ave. and Newberry St. to connect the north and south subway with west side lines. Future lines extending diagonally on the west side of the river are projected also.

The cost of the recommended system shown by the heavy full lines and heavy dotted lines in Fig. 1 is estimated at nearly $30,000,000.

The main features of the recommended plan comprise the two north and south through lines and the three west-side loops, as shown by heavy full lines and heavy dotted lines in Fig. 1.

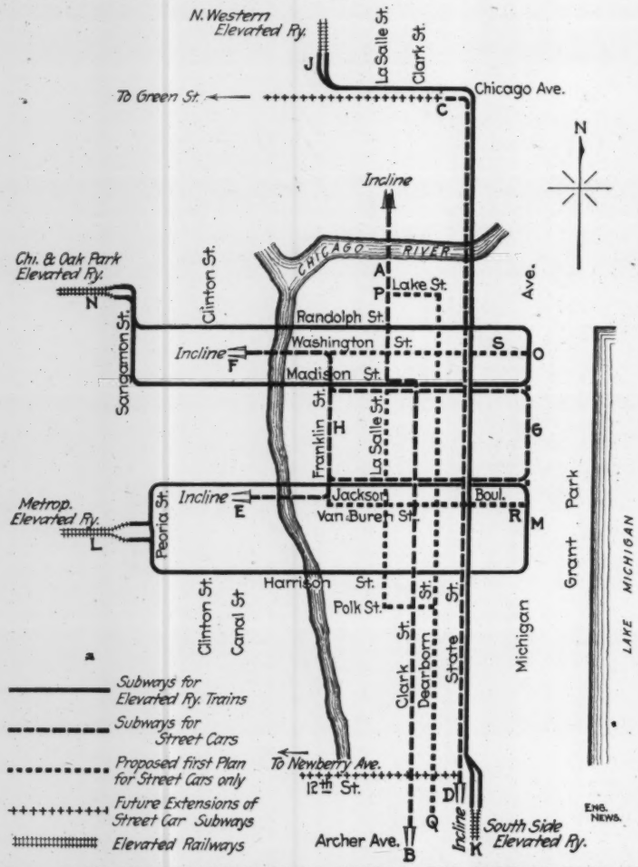


FIG. 1. PLAN OF CHICAGO SUBWAY SYSTEM (FOR SURFACE CARS AND ELEVATED RAILWAY TRAINS), RECOMMENDED BY MR. B. J. ARNOLD, M. AM. SOC. C. E.

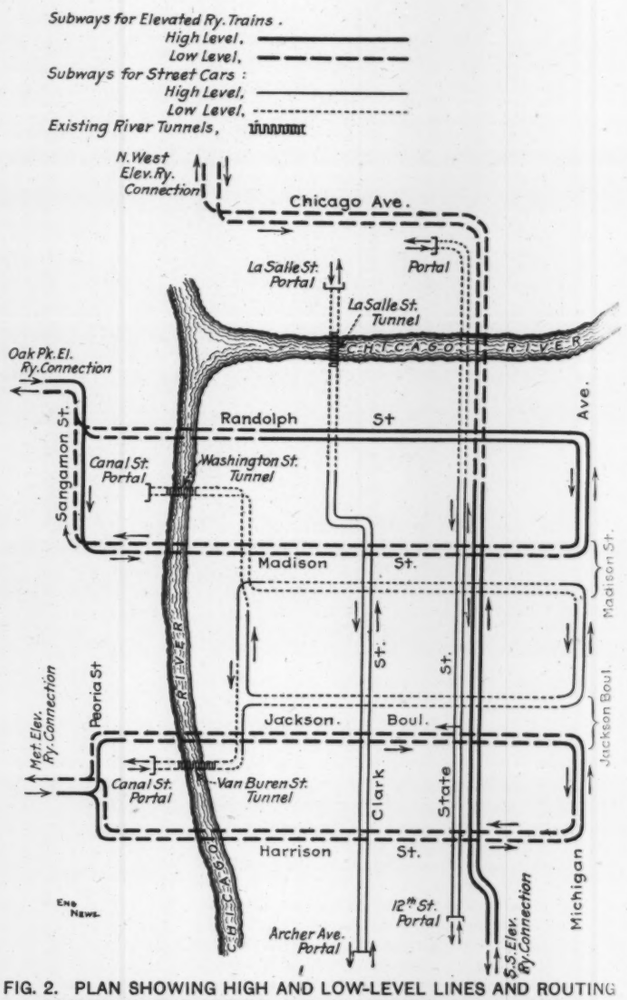


FIG. 2. PLAN SHOWING HIGH AND LOW-LEVEL LINES AND ROUTING OF CARS IN THE ARNOLD SUBWAY SYSTEM FOR CHICAGO.

(It will be noted that the Northwestern and Oak Park elevated railways run their trains "left-handed." This is done to avoid grade crossings at the connections with the present elevated loop, and the practice is followed on the proposed plan.)

The following extracts from the report relate to this part of the plan.

This plan is for a high speed, comprehensive system, designed to ultimately cover the entire city, in which could be operated high speed and local trains, independent of any of the present traction companies. Upon the tracks of this subway could be run at first the present surface cars, later the trains of the present elevated roads, and finally (when extended) the trains of a high-speed comprehensive subway system covering the entire city, thus making it possible to promptly relieve the present surface line congestion at moderate cost by constructing only a portion of the system at first, and later to eliminate the present elevated loop structure (if conditions should permit), and at the same time to have the nucleus of a high-speed subway system which could be extended as conditions warranted.

Fundamentally, no subway plan should be adopted involving any system of loops (or other methods of construction) which will prevent the building of a high-speed subway system ultimately covering the entire city. For no extensive subway system can be justified from an in-

	Single track, miles.	Stations, No.	Cost per mile.	Cost Total.
Double-track subway (A) to (B)	4.13	4	$726,710	$3,000,000
Loops (E, G, H, E) and (F, G, H, F)	3.66	6	1,364,950	5,000,000
Four-track subway (C-D) and (J-K)	10.184	5	768,550	7,750,000
Double-track loops (G-M) and (N-O)	9.50	14	1,421,100	13,500,000

*Engineering News, June 3, 1909 (with summary of previous article), and Aug. 19, 1909.

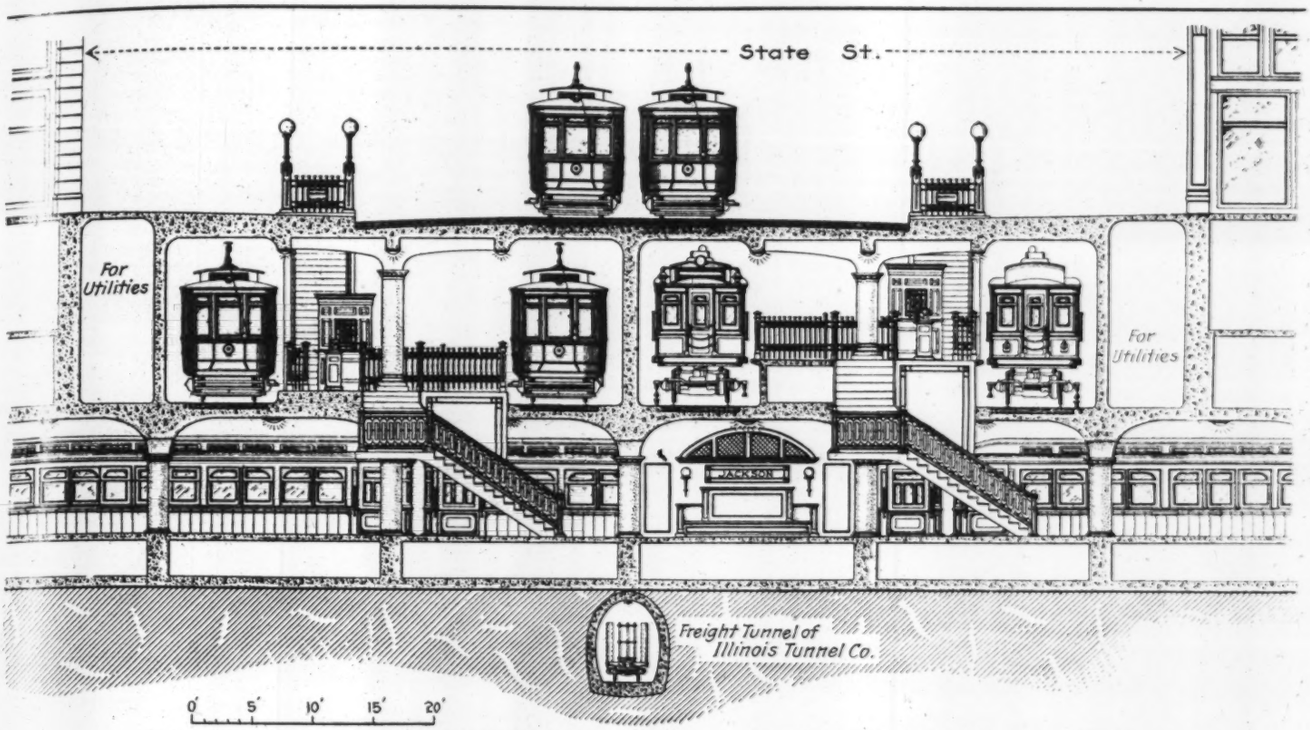


FIG. 3. SECTION OF DOUBLE-DECK STATION AT INTERSECTION OF HIGH-LEVEL AND LOW-LEVEL SUBWAYS.

This shows the intersection at Jackson Boulevard (Low-Level Station) and State st. (High Level Station). Each subway here has two tracks for surface cars and two tracks for elevated railway trains.

vestment viewpoint unless it is so designed that ultimately high-speed trains, each having a capacity of not less than 10 of the present elevated cars, could operate through it at times of maximum traffic. It is only by this method that the cost of operation per car-mile of such a system can be brought low enough to justify the heavy investment necessary for long-distance subways, and take care of the high fixed charges necessitated in their construction.

This does not mean that, aside from financial reasons, it is not advisable to construct at once enough subway in the business district to relieve the present congestion of surface and elevated cars. But it does mean that the ultimate plan to be kept in mind should be one that will lead toward securing a transportation system that (no matter how owned) will eventually gather the passengers by means of surface line cars and deliver them to high-speed subway or elevated trains. ' These, in turn, will bring them to and through the business district, the trains stopping infrequently, in order that high average speed may be made. The intermediate points between these stops will be served by the present surface cars or local elevated or subway cars. Since the city extends in three directions only it is necessary to return to the west side some of the cars coming from that side, by reversing their direction. This is accomplished in the plan under consideration by loop terminals in preference to stub-end terminals, for by the loop method continuous operation is permitted with the corresponding increased capacity and speed, and the elimination of danger in operation.

The east and west subways having descended to come under the river should remain down and pass under the north and south subways in the business district, although west of the river they could be constructed as high-level subways, but dipping to allow north and south subways to pass over them. The Randolph St. subway, however, must be at high level east of the river to allow the north and south subways to pass under the river at grades not exceeding those of the west side subways.

In such a system, no particular business district would be given any permanent advantage (or any advantage which the natural expansion of the system would not rectify) over any other business district, for the present business district, and ultimately the entire city would be gridironed with subways. Such a system can be constructed and operated more economically and involves less risk in operation than any other subway system suitable for Chicago conditions.

The plan provides through routing from the northern to the southern part of the city (and vice versa), as well as from some of the east and west streets and the diagonal subways, and some of the north and south subways. But it makes no attempt at universal through routing, by means of numerous branch routes such as are possible and practicable upon the surface with cars operating at moderate speed. To do so introduces expensive complications in construction and dangers in operation which do not seem necessary or wise. The plan does, however, make limited through routing possible; it brings the west-side citizens to the lake front without transferring; and it gives to all passengers the advantage of the universal transfer in numerous sheltered stations, thus tending to relieve the congestion which would occur if this transferring took place at few stations.

Subway Construction.

DESIGN.—After considerable planning and by adopting reinforced-concrete construction and in some instances combination I-beam and concrete construction, designs have been developed which will permit the cars of the elevated railways to pass through them, and which will not interfere seriously with the structure of the Illinois Tunnel Co., although at certain points this latter structure will have to be slightly changed. The general design permits a shallow construction for the high-level subways; it allows sufficient room for the low-level subways to pass under the high-level subways and over the Illinois Tunnel Co.'s structure; and it allows the low-level subways to be placed almost as close to the surface of the streets as the single-decked subways of other cities where mezzanine floors are used for the distribution of pasengers to the trains.

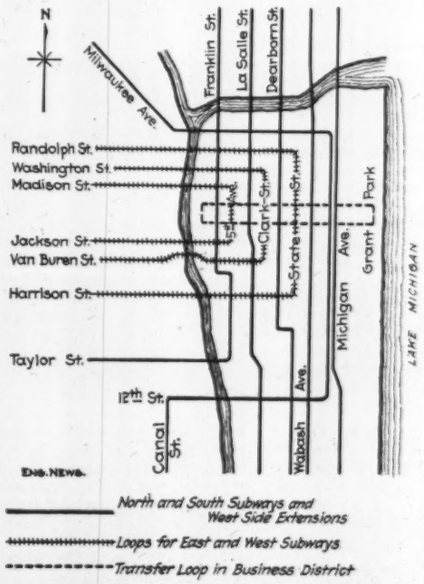


Fig. 4. Plan of Subway System for Chicago; Proposed by Mr. A. S. Robinson.

STATIONS.—In order to secure the advantages of shallow subways, making them easily accessible by stairways and greatly reducing their first cost, it has been found necessary to somewhat increase the width of the sidewalks of streets occupied by high-level subways. Otherwise it will be necessary to locate the entrances upon the present sidewalks close to the buildings, and reach the station platforms through deep stairways or escalators, and underground passages, and other stairways rising to the station platforms. This would necessitate the passengers descending a considerable distance, passing under the tracks and walking up stairs to reach the train platforms; unless underground grade crossings are adopted, which are prohibitive.

This necessity is due to the present location of the Illinois Tunnel Co.'s tunnels which are so near the surface that the general use of stations with mezzanine floors is impossible unless the entire passenger subway is lowered about 8 ft., thereby necessitating grade crossings, or the destruction of the Illinois tunnel structure in the business district, and greatly increasing the cost of the subway system.

Fig. 2 shows a station of the design recommended. The tracks are so located that the entrances can be made directly from the sidewalks without the use of mezzanine floor stations, except on Michigan Ave., where such stations have special advantages. This design will make the cars of the high-level subways easy of access from the streets by short flights of stairs, and when supplemented by escalators leading to the low-level subways, will make the street surface easily accessible to all passengers.

In general, the stations will be of the island platform type, the platforms for 10-car trains being 500 ft. long and those for street cars 250 ft. long (to accommodate four cars with safe space between them). The platforms will be generally 16 ft. wide, 42 ins. above the rails for elevated trains and 6 ins. high for street cars. Space for pipes, conduits and other facilities is provided on each side of the high level subways and above the low-level subways.

Drainage has been provided for water from heavy rains, broken water mains, etc., with automatic pumps or ejectors to discharge this into the sewers. Ventilation is provided for by means of electrically operated fans or exhausters. Ample provision is made for lighting the stairways and stations. Between stations, the subways will be lighted moderately by lamps so screened as not to trouble the motormen. The trolley wires of the surface lines and the third-rails of the elevated lines will be extended along the respective

tracks. A trolley wire will be carried also over each track for the elevated trains, so that surface cars can be operated over these tracks in emergency. As the elevated cars are generally equipped with trolleys (or can be equipped at small expense) these cars can be run on the tracks for the surface cars, so that a third-rail equipment on these latter tracks will not be necessary.

The Robinson Subway Plan.

In this connection we may mention a subway plan (for surface cars only) suggested by Mr. A. S. Robinson in a paper read before the Western Society of Engineers on Feb. 8. His plan (Fig. 4) provides for (1) a series of parallel north and south subways, and (2) a series of concentric loops connecting west side lines, so that cars coming in (eastward) on the most southern of the east and west lines would pass out (westward) on the most northern line. Some of the north and south lines, also, would be diverted to the northwest and southwest districts. The first lines would be the north and south subway on LaSalle St., and a loop on Van Buren, Clark and Washington Sts. to connect the two existing west side tunnels. There would be no grade crossings and no stations on the lower level, as all intersections would be between stations.

A special feature of the proposed system is a continuous belt or loop line in the business district. This would occupy Adams and Monroe Sts. (one block apart), and extend from the river to Grant Park. It would be a low-level line, intended as a transfer line only, and would necessarily have stations at the lower level (below the main stations).

AMERICAN SHIPBUILDING DURING 1910 was behind only that of England in the construction of merchant vessels. Of the 1,957,853 tons of merchant vessels built last year, 1,143,169 tons were launched from the yards of the United Kingdom, 331,318 tons from the United States and 159,306 tons from Germany.

Tests of Reinforced-Concrete Columns With Various Kinds of Transverse Reinforcement.*

This report deals with experiments undertaken at the Royal Material-Testing Station at Gross-Lichterfeld West, Berlin, at the instance of the German Reinforced Concrete Committee. The experiments, which were continued over the period 1907-1909, were particularly directed to the determination of the influence of different kinds of transverse reinforcement on the strength of columns.

Designs for reinforced-concrete columns were furnished by Messrs. Hüser & Co., the Concrete & Monier Construction Co. and Messrs. Dyckerhoff & Widmann. There were two series. All the columns of the first series were 2 m. (6.6 ft.) long, and 13 different forms of transverse reinforcement were used, as shown in Fig. 1. All the columns were of rectangular section, 30 cm. (11.8 ins.) square, except Nos. 12 and 13, which were of the same area, but octagonal in form, each edge being 13.65 cm. (5.4 ins.) The longitudinal reinforcing rods were 16 mm. (⅝-in.) and the transverse 7 mm. (¼-in.) in diameter. The transverse reinforcement was placed at equal intervals of 20 cm. (7.9 ins.). All were prepared from the same mixture of 1 part cement and 3 parts of an aggregate prepared by mixing graded gravel and sand in the proportions required to give a product with a minimum of voids. The cement and the steel were tested before the experiments, and were found to comply with the standard requirements for a slow-setting cement and mild steel, respectively.

As the result of some preliminary experiments, 9% of water was used in preparing the first column, but this being, in the opinion of those who witnessed the operation, too little, was increased to 9.5% for all the remaining columns. The water originally present in the aggregate was allowed for in all cases. The volume weights of the cement and aggregate were determined on quantities of 10 liters, and thereafter all materials were weighed instead of being measured. The concrete was mixed for one-half minute dry and two and one-half minutes wet in a Hüser mixing machine, and each quantity of 200 kg. (441 lbs.) was covered with wet cloths until actually used. The concrete was rammed in vertical wooden molds, which were wetted and not oiled.

The columns remained for three days in the molds and then for ten to twelve days standing on the iron base, the wooden molds being removed. After this they were preserved under a thick layer of moist sand until ten days before they were required. They were then transferred to the laboratory, placed horizontally, and their ends made accurately parallel by finishing with cement between steel plates. It was found that this layer of cement was perfectly preserved throughout the testing.

The compressive strength of cubes of this concrete, when mixed with 9.5% of water, was on the average 189 kg. per sq. cm. (2,690 lbs. per sq. in), while when only 7% of water was used it was a high as 264 kg. per sq. cm. (3,760 lbs. per sq. in.) or 40% greater.

Tests

All the tests were performed on columns 45 days old, a vertical 600-ton testing machine being used, equipped with a modified form of Martens' mirror apparatus for measuring the changes in length between two points 1 m. (39.4 ins.) apart, and with special level appliances for measuring the expansion in the direction of one of the diagonals.

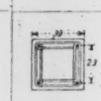
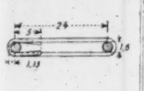
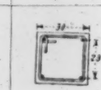
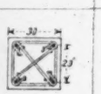
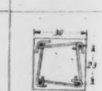
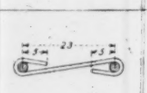
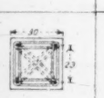
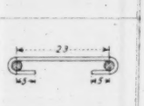
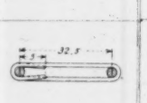
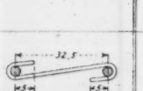
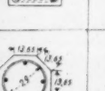
No.	Cross Section.	Details.	No.	Cross Section.	Details.
1			8		Like Nos. 3 & 7.
2		5 cm. hooks as in No. 1.	9		Like Nos. 4 & 7.
3			10		Like Nos. 1 & 5.
4					
5			11		Like Nos. 2 & 7.
6		Like Nos. 1 & 5.			
7		 Hooks like No. 2.	12		Hooks.
			13		Hooks, as in No. 12.

FIG. 1. DETAILS OF FIRST SERIES OF COLUMN TESTS.
(Dimensions in centimeters.)

The measurements obtained are recorded in a very lengthy series of tables. The following points become evident in the course of the tests:

SHIFTING OF REINFORCING LOOPS.—In accordance with the practice of the firms concerned, the transverse reinforcing rods or loops were not attached to the longitudinal rods by means of wires, but simply bent and put in place as the level of the concrete rose. The result was that they became displaced during the subsequent ramming, and very few were found to have retained their proper positions. The position of the fracture appeared, however, to be independent of the displacement. In some cases the transverse loops were no longer parallel, but no bending outwards of the longitudinal rods was observed at the points of greatest separation of the loops.

INFLUENCE OF THE LONGITUDINAL REINFORCEMENT.—Experiments in which loads were repeatedly applied and removed showed that for small loads the

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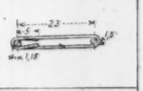
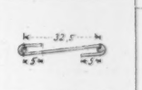
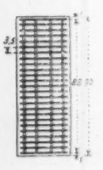
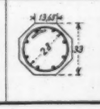
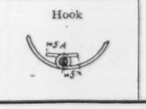
14			
15		Length of hook, 5 cm.	
16			
17		Hooks as Nos. 15 and 16	
18	None		
12			
20		Hook 	

Fig. 2. Details of Second Series of Column Tests.
(Dimensions in centimeters.)

compression was practically the same each time the load was applied, but that for heavy loads the compression increased, and was not constant even after ten applications. This is of importance, as the figures show that, although the longitudinal rods were permanently shortened by such treatment, the load applied to them was far below their elastic limit. It follows, therefore, that the distribution of stress between the steel and the concrete must have been greatly altered during the loading, the proportion of the stress borne by the steel being increased. As the steel was not found, after destruction in the machine, to have slipped, it follows that the compressive stresses in the steel must have been balanced by tensile stresses in the concrete; in fact, the permanent compression in such columns was found to be less than in similar columns without reinforcement, subjected to the same loads and to the same number of alterations.

INFLUENCE OF THE TYPE OF TRANSVERSE REINFORCEMENT.—The numerical results of the tests are summarized in Table I. Each result is actually the mean of the results obtained from three exactly similar columns. The numbers refer to the sketches of reinforcement in Fig. 1, where details are given.

A comparison of columns 1a, 2a, and 12a, which had no longitudinal reinforcement, with the non-reinforced columns "O" shows that transverse reinforcement alone is practically without influence on the amount of compression. On the other hand, when longitudinal reinforcement is present, its influence is greatly assisted by the presence of transverse reinforcement. Reinforcing rods or loops parallel with the sides are much more effective than diagonal loops, and in such cases as columns 6 and 9 the presence of diagonal as well as lateral reinforcement results in an actual increase of the deformation, instead of a decrease. The measurements of lateral expansion show that, almost without exception, great expansion accompanies great compression. The figures for expansion are therefore not re-

*From "Concrete and Constructional Engineering," January, 1911. This report is abstracted from "Versuche mit Eisenbeton-Säulen," published by Messrs. Wm. Ernst & Son, Berlin, an account of Prof. Rudeloff's experiments at the Royal Testing Laboratory at Gross-Lichterfelde West, Berlin.

produced in the present abstract. The ratio between compression and diagonal expansion is irregular, but has an average value of 6.5.

CRUSHING STRENGTH OF COLUMNS.—Notes were made of the state of the weather at the time of preparation of each column, and the results show that those prepared in moist, rainy weather were always weaker than those prepared in dry weather with the same reinforcement. Every column broke at the end which was uppermost during ramming, whether this end was placed upwards or downwards in the machine during testing, showing clearly that the solidity of a concrete column diminishes towards the upper end. Measurements of the specific gravity after saturating with water showed that the concrete diminished in density upwards.

Longitudinal reinforcement alone has little or no influence on the strength, but increases the modulus of elasticity. Reference may be made to a few columns in which the longitudinal reinforcement was not continuous, but was cut up into lengths of 20 cm. (7.9 ins.).

The general conclusion to be drawn is that the type of transverse reinforcement employed has a surprisingly small influence on the strength of the columns, certainly less than the conditions under which the columns are prepared and rammed. The results indicate, however, that transverse reinforcement consisting of a continuous rod wound round the longitudinal rods and bent over at the ends gives better results than short rods hooked at each end. Diagonal reinforcement, or alternately diagonal and lateral, is unfavorable, as is seen particularly in the fact that columns reinforced in such a manner develop cracks long before the application of the ultimate breaking load. Lateral reinforcement leads to the development of transverse cracks and to the shattering of the concrete, but only when the ultimate breaking load is reached. Octagonal columns also behave better when reinforced with a single rod wrapped completely round than with a number of short-hooked rods.

Second Series

The results of the foregoing tests having been discussed by the committee, it was decided to carry out certain further experiments, utilizing the experience already gained. Columns were prepared from the same materials (the later consignment of cement, however, giving a stronger mortar), but the ballast was sifted and graded, and definite quantities of each grade used. The proportion of water was reduced to 8.2%, and the wooden molds were neither oiled nor wetted. In order to avoid the influence of weather the columns were prepared indoors. The transverse reinforcing loops were placed 15 cm. (5.9 ins.) apart, and in order to guard against accidental displacement were wired to the vertical rods before introducing the concrete. The steel pins required for the measurements were rigidly attached to the reinforcing rods instead of being inserted in the concrete as in the first series.

The types of reinforcement used are shown in Fig. 2. It will be seen that, in addition to some minor modifications in the arrangement of the reinforcing loops, the octagonal columns, 19 and 20, were prepared with eight longitudinal reinforcing rods. No. 19 having spiral reinforcement and No. 20 reinforcing rings. The spirally reinforced columns were constructed under the direction of Messrs. Wayss & Freytag. The total length of each column was only 90 cm. (35.4 ins.) instead of 2 m. (78.7 ins.), and the changes of length were measured between points 50 cm. (19.7 ins.) apart.

The numerical results are summarized in Table II. As before, each result is the mean of the results from three exactly similar columns. The numbers correspond with those in Fig. 2, from which the nature of the reinforcement may be found.

Transverse measurements at different heights showed that in all cases the columns became bulged under load, although to a less extent than in the columns containing no reinforcement. The columns with S-diagonal reinforcement showed the least swelling. The ratio of longitudinal compression to lateral expansion was much less in the second series than in the first, being about 2.3 instead of 6.5. This difference is probably due to the greater density of the concrete in the second series, the denser concrete naturally yielding less under compression.

As before, fracture took place at the end which was uppermost during ramming. The pyramidal fracture was generally well developed. The ultimate fracture of the spirally reinforced and hooped columns was accompanied by the breaking of the hoops at several distinct points.

The greatest strength was given by the spirally reinforced octagonal columns, the hooped octagonal columns coming next in order. The columns without reinforcement were the weakest. Of the square columns, the best results were given by the O-loops (14) and the worst by the continuous reinforcement (15), this result being in decided contradiction to that obtained in Series I. As before, it was found that the presence of diagonal as well as lateral reinforcement in the same section actually weakened the columns.

The steel used for the spiral reinforcement was of exceptionally high tensile strength. It appears that this fact influences the breaking load, but not the point at which cracks appear. Yielding of the hooked ends of reinforcing loops was not observed in any case.

The fact that the upper end of a column always proved to be the weakest part suggested some special experiments with columns not containing any reinforcement. Nine columns were therefore prepared, each 2 m. (78.7 ins.) high and 30 cm. (11.8 ins.) square, in the same wooden molds. The proportions of cement and ballast were varied, three columns each being prepared of 1:2, 1:4 and 1:6 mixtures. Immediately after ramming samples were taken from the top, middle, and bottom for the determination of the density and water-content. The results showed that the proportion of water after stamping is very considerably less than that in the original mixture lean mixtures losing the least. Only a small part of the loss is to be attributed to chemical combination, as the time elapsing before taking the sample was considerably less than the setting time of the cement. The water-content increased from the base of the column upwards. The proportion of cement increased slightly upwards. On the other hand, the density of the concrete was very markedly greater in the lower portions of the columns.

TABLE I.

	No.	Longitudinal reinforcement.	Transverse reinforcement.	Compression in parts per 10,000,000 under load of 87 kg. per sq. cm. (1,240 lbs. per sq. in.)	Load at Cracking. Kgs. per sq. cm.	Load at Cracking. Lbs. per sq. in.	Load at Fracture. Kgs. per sq. cm.	Load at Fracture. Lbs. per sq. in.
	0	None	None	855	140.6	2,000	140.6	2,000
	1	Continuous	4 O-links.....	616	133.6	1,900	133.6	1,900
	2	"	Continuous	586	153.4	2,180	153.5	2,180
	3	"	4 S-links	617	158.1	2,250	158.1	2,250
	4	"	4 C-links.....	705	148.4	2,110	154.1	2,200
	5	"	2 Diagonals	654	131.0	1,860	151.6	2,160
	1a	None	4 O-links	946	131.3	1,870	131.4	1,870
	2a	None	Continuous	584	134.0	1,910	135.4	1,930
	1c	Short lengths...	4 O-links	686	162.9	2,320	162.9	2,320
	2c	Short lengths...	Continuous	850	129.4	1,840	131.6	1,870
	6	Continuous	4 O-links and 2 diagonal...	711	119.3	1,700	150.9	2,140
	7	"	Continuous and 2 S-Diag...	714	124.8	1,770	151.2	2,150
	8	"	4 S-links and 2 S-diagonal.	677	125.8	1,790	153.0	2,180
	9	"	4 C-links and 2 S-diagonal.	744	117.6	1,670	135.1	1,920
	10	"	Alternately O and diagonal.	801	103.4	1,470	132.2	1,880
	11	"	Alternately Cont. & Diag..	539	106.7	1,520	136.8	1,950
Octagonal	12	Continuous	Continuous	518	157.6	2,240	157.6	2,240
Octagonal	13	"	Overlapping rings.....	...	125.7	1,790	145.7	2,070
Octagonal	12a	None	Continuous	726	155.9	2,220	156.2	2,220
Octagonal	12c	Short lengths...	Continuous	700	113.1	1,610	131.1	1,870

TABLE II.

No.	Longitudinal reinforcement.	Transverse reinforcement.	Compression in parts per 10,000,000 under 113 kg. per sq. cm. (1,610 lbs. per sq. in.)	Load at Cracking. Kgs. per sq. cm.	Load at Cracking. Lbs. per sq. in.	Load at Fracture. Kgs. per sq. cm.	Load at Fracture. Lbs. per sq. in.	Mean stress at fracture, lbs. per sq. in. Concrete.	Mean stress at fracture, lbs. per sq. in. Steel.
14	4 rods, 16 mm. (⅝-in.)	4 O-links.....	734	193.5	2,750	196.8	2,800	2,730	41,000
15	"	Continuous	853	170.2	2,420	176.6	2,510	2,460	37,000
16	"	2 diagonal S-links.	697	185.5	2,640	187.0	2,660	2,600	39,100
17	"	Continuous and 2 diagonal S-links..	...	168.0	2,390	178.3	2,540	2,490	37,400
18	None	None	1,265	153.4	2,210	155.4	2,210	2,450	....
19	8 rods, 11 mm. (7/16-in.).....	Spiral	1,057	191.6	2,730	208.6	2,970	2,930	44,100
20	"	Rings	...	196.4	2,790	200.0	2,850	2,800	42,100

Annual Convention of Brick Manufacturing Interests.

A convention of brick manufacturers associations was held at the Seelbach Hotel, Louisville, Ky., from Feb. 6 to 11, with an attendance of over 500 members and visitors. Some of the sessions were executive meetings for the transaction of business, and many of the papers presented at the public sessions dealt with matters of trade rather than with technical matters. The associations included the National Brick Manufacturers' Association, the Building Brick Association of America, the National Paving Brick Manufacturers' Association, and the National Clay Machinery Association. Their meetings are always held at the same time and place, but on different days. The next convention will be held at Chicago in February, 1912. In connection with this, the machinery association is planning to hold a Brick and Clay Products Exhibition (including machinery and appliances as well as products) on the same plan as the Cement Exhibitions which have now become an annual institution of the cement and concrete interests.

At the Louisville meeting there was an extensive exhibit of brick (paving, building, face, fire, etc.), and of machinery and appliances for brick yards and brick works. They were largely scattered in various rooms of the hotel, however. A number of the exhibits were placed in the hall where the meetings were held, with the result that the meetings were subject to continual disturbance in spite of frequent admonitions from the presiding officers.

National Brick Manufacturers' Association.

This is the main or parent association, and its meeting (the 25th) occupied three days. Mr. Geo. H. Tefft (Kansas City, Mo.) gave an address on the manufacture and use of vitrified sewer and culvert pipe, which was illustrated by stereopticon views. Prof. John R. Bell (Pennsylvania Industrial Reformatory) gave an address on trade schools and how they may benefit the brick manufacturers by training boys in common and decorative brick laying. A paper on "The Rejuvenation of Brick Plants," by E. Ogden (Zanesville, O.) dealt with methods of putting such plants in position to meet modern economic and industrial conditions. In the discussion, Mr. R. G. Eisenhart (Horseheads, N. Y.) advised manufacturers to have plans of their plants and appraisals of their value made by an appraising company. These show all buildings, machines, etc., and also are kept up to date as alterations and changes are made. In case of damage to the plant by fire, the plans and valuation are of the utmost value in proving to the insurance companies the extent of the loss sustained.

Papers on natural draft and artificial draft in drying clay wares were presented by John C. Boss (Elkhart, Ind.), who is the inventor of a drying system, and by C. Steadman (Greenridge, N. Y.). The former referred to the use of hot air and exhaust steam, and advocated a system which dispenses with the usual drying tunnels and cars. He explained that air having to pass horizontally the full length of the tunnel before reaching the escape stack is likely to deposit some of its moisture (removed from the brick) as condensation on the walls, causing trouble with the quality of the brick. Both papers advocated forced draft in preference to natural draft. Mr. Bloomfield (Metuchen, N. J.) had avoided such troubles by increasing the capacity of the tunnel towards the outlet end; this is done by raising the roof on an incline. He utilizes waste heat for the kilns, and this is satisfactory if the heat is not drawn off until the kiln has rested for a few hours after burning. If it is drawn off while the burning is in progress or immediately after its completion, trouble occurs in the drying process.

Mr. Julius J. Koch (St. Louis) presented a paper on the comparative values of fuels for burning brick, in which he advocated oil as very successful when it is intelligently applied. He described the proper methods to be used in burning oil fuel. He referred also to the modern system of purchasing fuels (and determining their values) by their heat-unit contents.

A paper by Prof. A. V. Bleininger (University of Illinois) on the manufacture and testing of firebrick led to an animated discussion, in which Mr. Bloomfield pointed out that different qualities of firebrick are required under different conditions. For this reason it is not possible to grade firebrick definitely as the best (or No. 1) brick for one purpose may not be the best for another purpose. Mr. J. E. Howard (U. S. Bureau of Standards) outlined some tests of slag brick, and showed views of the Indianapolis brick-paved speedway for automobile races and commercial tests. He showed also a number of views of the laboratory of the U. S. Bureau of Standards and its equipment. A paper on "Manganese Steel Applied to the Ceramic Industries," by Mr. Geo. Kneisly (Chicago) described the character and properties of this steel and its advantages for the crushing heads and jaw plates of gyratory and jaw crushers, the tires of grinding rolls, the bottom plates of dry pans, etc., as well as for gears, etc. Its high cost is much more than counterbalanced by its great durability. This does not apply, however, to parts which require to be machined.

One of the topical subjects of discussion was: "Is it feasible to combine the manufacture of hollow block with that of common building brick?" Mr. Bloomfield (Metuchen, N. J.) thought it both feasible and highly desirable, not only for commercial (or financial) reasons but also to help in promoting the increased use of fireproof building construction. He had used the same machines for both brick and block making, but other speakers had found it preferable to instal special machines for the hollow blocks.

The officers elected for 1911 are as follows: President, Charles M. Crook, Youngstown, O.; Secretary, T. A. Randall, Indianapolis, Ind.

Brick as a Paving Material.

The National Paving Brick Manufacturers' Association held no public meetings, and had no papers on technical subjects. It took important action, however, in officially adopting as its standard a new form of rattler for testing brick. This is a modification of the rattler hitherto used. Officers were elected as follows: President, Charles J. Deckman, Cleveland, O.; Secretary, W. P. Blair, Indianapolis, Ind.

The subject of brick paving did come up for some discussion, however, at one of the meetings of the National Brick Manufacturers' Association, as a result of the views shown by Mr. Howard illustrating the Indianapolis motor speedway. Mr. Blair (Indianapolis) remarked that macadam paving had been found unable to stand under the very high speeds attained, while the brick has proved permanent and has no tendency to cause skidding of the wheels. Mr. A. Ittner (St. Louis), referring to ordinary street paving, advocated laying the brick at an angle of 45° with the curb, so that wheels will cross the joints diagonally. Another member thought this might be dangerous, from the calks of horses' shoes catching in the diagonal joints, which (with the cement grout) are apt to be lower than the face of the paving. Mr. Ittner also opposed the idea that good paving bricks can be made from clay suitable for building bricks. Mr. Blair considered diagonal joints quite unnecessary, as a well laid brick pavement should have a smooth and even surface; furthermore, they would make trouble in getting good closures and close joints at the gutters. He referred to the great durability of good brick paving, and cited a pavement which has carried a very heavy traffic for 19 years and still is in excellent condition.

One of the topical subjects for discussion by the main association, also, was the following: "Is the use of 2-in. cubes of vitrified clay practical in the construction and resurfacing of worn-out public roads?" This was discussed briefly by Mr. W. H. H. Rogers (Rochester, N. Y.), who referred to the experiments made on the New York State roads, as described in Engineering News of Feb. 2. Mr. M. E. Gregory (Corning, N. Y.) objected to the method; he thought that it would cost no more to lay the road with paving brick, and that this would be more durable, besides requiring less repair. We may note that he overlooked the fact that the greater thickness of brick would increase the amount of material, and that a cushion course of some kind would be required. The cube system is proposed as a species of macadam, and is quite distinct from brick paving.

Brick as a Building Material.

The Building Brick Association of America (having its offices in New York) is an organization composed of representatives of brick manufacturers and was established specially for the purpose of conducting a campaign of publicity in order to educate the public (and architects and contractors also) as to the advantages of brick as a building material. It was pointed out at the meeting, by Mr. R. E. Sunderland (Omaha, Neb.), that manufacturers as individuals have done very little in this direction, partly because the field of each one is limited, and the cost would be relatively high. At the present time there is much greater publicity and more advertising as to wood, concrete and stucco buildings than there is in regard to brick buildings. The money subscribed to this association is expended partly in getting and publishing designs of brick buildings of different types, and partly in advertising in technical and trade papers and in the popular magazines. The campaign is being made especially for residence buildings of moderate cost, which represent an enormous annual aggregate in number and value. It will be extended, however, to include industrial buildings and the more costly styles of residences.

The association held one very interesting public meeting at which these matters were discussed. A paper on "The Cheapness and Durability of the Brick Veneered House," by W. E. Dunwody (Macon, Ga.) presented the advantages of this type of construction over wood construction for the southern states. Mr. John Andres (Evansville, Ind.) described the methods employed by himself and a local organization in conducting a campaign for brick. He showed by lantern slides a number of brick residences, factory buildings, etc., and also several of the advertisements placed in the local papers.

In a paper by Mr. Parker B. Fiske (New York, N. Y.) it was pointed out that brick buildings have great economic advantages over wood buildings in durability, in fireproof qualities, and in cost of maintenance and repair; they are also cooler in summer and warmer in winter. An objection against them, however, which has been regarded as fundamental and inevitable, is that of the greater first cost. It has been assumed very generally, by builders as well as by the public, that the cost would be from 25 to 35% higher than for wood buildings of similar character, or so high as to be prohibitive for investment purposes.

To determine the facts of the case, the association commissioned a firm of architects to prepare plans of an 8-room residence for nine different styles of construction. These plans were then submitted to several experienced contractors, and detailed estimates and bids were made. The bids showed that the difference in cost for the different designs were comparatively small, the maximum being 10 to 13% greater for the building with 12-in. solid brick walls than for the wood building with common clapboard covering. The designs and the figures were shown on lantern slides by Mr. Fiske, and the averages of the several bids on the different types of construction ranged as follows:

COST OF EIGHT-ROOM RESIDENCE OF DIFFERENT STYLES OF CONSTRUCTION.

1.	Wood, with clapboard covering	$6,760
2.	Wood, with shingle covering	6,868
3.	Stucco on wood	6,953
4.	Brick veneer on wood studding	7,174
5.	Stucco on hollow blocks	7,188
6.	Brick veneer on boarding	7,266
7.	Brick with 10-in. hollow wall (2-in. air space)	7,372
8.	Brick veneer on hollow blocks	7,483
9.	Brick, with 12-in. solid wall	7,641

Supplementing this subject, Mr. Fiske discussed that of the possibility of greatly increasing the market for brick. An analysis of building records shows that in the aggregate the residences of moderate cost which are now built ordinarily of wood afford an enormous field for development in the use of brick. Some makers have had the idea that this business is too small to be worth cultivating, which seems to be an erroneous idea.

A Swinging Hand Derrick for Construction Work.

We illustrate herewith a revolving hand derrick which is coming into use as a substitute for the more cumbersome guyed derricks on buildings where the weights to be lifted are moderate. It dispenses with guys and stiff-legs, and has the advantage of being able to swing a load and place it on the floor as well as to set building blocks, masonry, etc., in place directly beneath the derrick. The accompanying cut shows the derricks in use on three six-story buildings.

The main post is attached to a pair of sills, and when in use these are anchored to the floor by three bolts, the nuts being screwed up against cleats beneath the joists. The post carries a braced boom with a hoisting sheave and a hand operated winch that gives a rapid rate of hoist.

A HAND-OPERATED SWINGING DERRICK FOR BUILDING AND OTHER CONSTRUCTION WORK.
Sasgen Brothers, Chicago, Makers.

The clear height is 8 ft., and the boom covers a circle of 12 ft. diameter. The boom revolves on the post and can be locked in any position, so that it will swing only as required. The hoisting capacity is 1,000 lbs., but this can be increased to 1,500 lbs. by tripling the cable and attaching a wire guy to the top of the post. The total weight is only about 250 lbs., and the machine is set up or shifted very readily and quickly. Large and smaller derricks are made with hoisting capacities of 500 to 2,000 lbs. A longer boom can be fitted to enable wheelbarrows to be hoisted, and for such work the cable may be led down to a block on the ground and operated by a horse or other power.

The machine was designed specially for work on building construction, being used to hoist materials and set in place the joists, masonry, window frames, etc. It has been used also, however, on concrete construction work for handling form material and reinforcing bars, and for shifting forms from place to place as the work progresses. Three of the derricks were used in the form construction for the Grand Ave. viaduct at Milwaukee, Wis., which is 2,100 ft. long and has arches of 60 to 145 ft. span.

A modified form of this derrick, with a counterbalanced boom, has been used for loading castings and other heavy material on wagons and railway cars, and is adapted to other kinds of work. The inclined boom (stiffened by a truss rod) extends beyond the rear of the post to a connection with a horizontal strut, and at this point is suspended a counterweight.

The derrick is patented and is manufactured by the inventors, Sasgen Brothers, 2053 Racine Ave., Chicago.

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Entered at the New York Post-Office as Second-Class Matter

The various bills introduced in the New York legislature requiring engineers to be licensed are to be the subject of a hearing by the Senate Committee on Public Education about March 1. We expressed our opinion on this proposition a month ago, in our issue of Jan. 26. We need only repeat here that these proposed laws will not benefit or protect the public; but will tend to mislead it with the idea that if an engineer has a license he may be safely placed in responsible charge of important work. Neither will these proposed laws benefit in any way the engineering profession. On the contrary, it will place on every engineer an unnecessary and objectionable tax, which will become a serious burden on every engineer who is obliged to go from one state to another in carrying on his work, as is the case with most engineers.

If the legislature of any state sees fit to pass a properly framed law requiring every one who practices land surveying to be examined and licensed; or one requiring every structural designer to be examined and licensed, or one requiring every engineer engaged in building municipal water-supply plants to be examined and licensed, we can see some valid arguments to be brought in support of such measures.

But the State proposes to grant a license to a man to practice civil engineering and to declare under the official seal of the State that the man is "properly qualified to practice civil engineering," which the law defines to be any branch of the profession of engineering other than military! There is about as much sense in such a proposition as there would be in declaring under the State's official seal that a man was properly qualified to keep a hotel, run a steam shovel, act as cashier of a bank, fill teeth in a dentist's office and practice law.

No reputable and honest engineer, no matter how eminent in the profession, would dream of claiming himself competent and qualified to practice in all branches of the engineering profession. Yet here is a law which proposes to guarantee his competency to this extent and threatens him with punishment if he attempts to earn his living without securing an official certificate which is false upon its face!

We urge our readers resident in New York State to inform themselves and fully realize what sort of burdens and restrictions the engineering profession is threatened with. If they do not wish to see the profession thus tied up with knots of red tape, if they do not want to see engineers forced to pay out their hard earned money to lawyers in order to protect themselves from the abuses which are pretty certain to creep into the administration of a law of this sort, sooner or later—if they wish to make some effort to protect themselves from such burdens before it is too late, we advise them to forward emphatic protests to their Senator or Representative at Albany, or to the Chairman of the Senate Committee on Education. If they can follow this up with personal interviews with any members of the legislature with whom they may be personally acquainted, so much the better.

A well-known engineer in the West writes to us requesting a few editorial remarks respecting the habit of some engineers of seeking free advice from their professional brethren.

He encloses a letter which he has received from an engineer whom we will call Jones, because that is not his name. Mr. Jones has written a long letter to our correspondent describing an engineering work which he, Jones, has undertaken and whose design involves some factors of uncertainty on which there is comparatively little to guide in the way of engineering precedent.

Our correspondent, whom we will call Mr. Robinson, also because that is not his name, has built a somewhat similar work which is completed and in operation. Mr. Jones therefore asks Mr. Robinson if he will kindly tell him how the job he has finished is behaving. He writes a two-page letter explaining the conditions which he, Mr. Jones, is up against, and says he will greatly appreciate an expression of Mr. Robinson's opinion with reference to the difficulty which Mr. Jones has encountered.

Mr. Robinson's reply to this request is so brief that it may well be printed in full as follows:

Sir: Replying to your query of Jan. 24, I enclose attached form. Hoping in advance that it may prove instructive and entertaining, I remain,

Yours respectfully,
John P. Robinson.

Form 7—1908.

A certain lawyer of New York, famous in his time, had a habit of taking a daily walk in Battery Park. A merchant joined him in his walk and told him of a law case to which the merchant was a party. To the merchant's question the lawyer replied, that the facts being as stated, the law was so and so.

Next the merchant engaged a cheap lawyer to conduct the trial and lost his case. He then called at the famous lawyer's office and reproached him for giving an opinion which had caused the merchant heavy financial loss. The lawyer replied by calling to his clerk: "John, bring me my fee book." "Oh, no," said the merchant, "you will not find it there. Don't you remember that one day while walking in the Battery you told me so and so?" "Oh, yes," said the lawyer, "I remember it now very well. That was only one of my Battery opinions, and between you and me they ain't worth a damn."

The joke is certainly a good one. But, treating the matter seriously, there is undoubtedly something to be said on both sides. It is, we believe, common among lawyers and doctors, and more or less common among engineers, to give advice to brother members of the profession without charge, provided it is proper for the advice to be sought and given. On the other hand, one should not ask another to give any considerable amount of time without compensation or to give an opinion gratis which should properly be paid for. The practice in both the legal and medical professions is that when the man in charge of a case finds a point on which he is in doubt, he advises his client that there is need for consultation with and advice from another practitioner.

Perhaps some light may be thrown upon the subject by explaining our own practice in this matter. The editors of Engineering News receive many letters in which advice is asked on engineering matters. When the question presented is one which should properly be referred to a consulting engineer for an opinion, it is our custom to so advise the inquirer.

There are several reasons for this. One is that the editors of Engineering News are too fully occupied with their regular work to take the time to study and prepare opinions upon matters of ordinary engineering practice which should properly be given special study by some engineer competent in the particular field to which they relate. A second reason is that to give a really reliable and valuable opinion in such cases, it is almost always necessary that a study of the conditions should be made upon the ground. Were we to attempt to render an offhand opinion, based upon such statements merely as the letter of the inquirer might contain, it would be subject to the same valuation as was placed upon his "Battery opinions" by the eminent lawyer quoted above. Any engineer who values his reputation will be careful, before rendering any opinion for which he may be held responsible, to see that he knows all the facts regarding the case and to verify these facts, usually, by personal examination.

On the other hand, questions come to us very frequently which relate to matters in which practice is uncertain, and where a general discussion by engineers may lead to the shedding of light upon a subject and be of aid and value to many other practitioners as well as the inquirer. Such questions it is our practice to publish in Engineering News.

The application of the rules which we have outlined above to the relations between engineers is, it seems to us, comparatively simple. An engineer should not expect to take the time of a brother engineer for the study of his own problems and for the preparation of an opinion which should properly be paid for, unless he provides that the engineer whose opinion is thus asked should be properly compensated. On the other hand, engineers generally, we believe, are willing to assist each other in the matter of data and experience regarding the works with which they have been connected.

In some of the discussions that have taken place on a code of ethics for engineers, it has been pertinently remarked that the Golden Rule is about as complete and perfect a code of ethics as could be devised. If the engineer who wishes to take the time of a professional brother will consider in the first place whether he himself would be ready and willing to grant the favor he asks for, provided he were in the position of the man to whom he proposes to write, he should be able to judge whether he is asking something which should be readily granted or not. On the opposite side, the engineer who receives an inquiry from a brother member of the profession, if he will imagine himself in the place of the questioner, ought to be able to judge fairly whether the question is one which he would himself ask were the positions reversed.

At the risk of too much repetition we are publishing in this issue another and more explicit account of the collapse of the Henke reinforced-concrete building in Cleveland, which has already been the subject of several articles in our columns. This latest description is the first in which the real conditions of construction and the irregular preliminaries to the design have been clearly set forth, and for that reason it should be read carefully by those engineers who have already accepted the conclusions reached by the Commission appointed to investigate the collapse. It is evident that the peculiar carelessness that attended the entire matter could have resulted in nothing short of disaster.

There seems to be an impression in certain quarters that our previous editorial comment on this subject (Eng. News, Jan. 26, 1911, p. 105) was adversely critical of the investigating Commission, in that it accused the Commission of exonerating the design without sufficient study. This was quite far from our intention, which was merely to call attention to the fact that the probable nature of construction must always govern design to a considerable extent, and that what is a good design when the designer is sure of the building methods to be used may be an objectionable design when the designer has no authority or certainty beyond the drafting room. So far as we can ascertain, the Commission did not recognize this fact.

More Concerning Postage Rates on Publications and Railway Mail Pay.

We briefly discussed in this column last week the proposed increase in rates of postage on the advertising pages of periodicals other than newspapers. It has seemed to us that further discussion might be of interest to our readers, particularly with respect to the payments to the railway companies for handling the mails.

At the outset we would repeat our expression of approval of the work Secretary Hitchcock is doing to place the Postoffice Department on a better business basis. We believe, furthermore, that, taken as a whole, the Department is at present conducted with at least as great efficiency and economy as the average business of equal magnitude and an equal amount of detail carried on by a private corporation.

That there is still large room for improvement, however, is abundantly shown by the last report of Secretary Hitchcock, himself.

Turning now to the postage rate on second-class mail matter: as we showed last week, the Department's estimate that the cost of carrying such matter is 9 cts. per lb. is based necessarily on the rates paid to the railways for carrying the mail. These rates, which are fixed by statute, are based upon the pounds of mail carried and the distance over which it is carried. Hence upon these railway mail payments is also based the Department's estimate that the cost of handling the periodicals of general circulation carried an average distance, by the Department estimate, of 550 to 1,100 miles is much greater than the cost of handling the newspapers, whose average radius of distribution is less than 300 miles. Quoting from Postmaster-General Hitchcock's report for 1909:

> While the average haul of magazines proper is over 1,000 miles and that of other classes of periodicals, not including daily newspapers, ranges from 550 to over 1,100 miles, the haul of daily newspapers, which comprise about 40% of the second-class mail, averages less than 300 miles. The cost of transportation by rail and by other means forms slightly more than a third of the total expense of handling second-class mail. Magazines proper, because of their long average haul, show a cost of more than 5 cts. a lb. for transportation, while in the case of daily newspapers, for which the average haul is much less, the transportation cost is less than 2 cts. a lb.

It is interesting to trace the evolution of the present system of railway mail pay. The first law concerning it was passed by Congress July 7, 1838, and provided merely that the rate of pay should not be increased more than 25% above what similiar service by stage coach would cost. The underlying idea, evidently, was that the faster service furnished by the railway might be paid for at a higher rate. It was not realized that the great reduction in cost of transportation effected by the railway was a benefit which the public was entitled to share.

The present scale of railway mail pay is based upon a law passed in 1873, which fixed a graduated scale of payments per mile per annum, according to the weight of mail carried. These payments were modified in 1876 and 1878 by changes in the amounts; and in later Congresses acts have been passed reducing the rate of payment by percentages, on routes where over 5,000 lbs. of mail per day is carried. Thus the statutory figures for such payments are now reduced by 10% and 5% and 5% over the amounts originally fixed.

In addition to the payments based on the weight of the mails carried, the railways receive a rental for postal cars in the service, which is fixed at $25 to $40 per annum per mile of daily run, according to the length of the car. Thus a 55-ft. postal car, run every day over a postal route 300 miles long will earn for the railway company $12,000 a year.

If the payments for the weight of mail carried are fairly compensatory to the railways, then the rental paid the railways for the use of postal cars is grossly excessive. If proof of this is needed we offer the standard rates of rental fixed by the railways themselves for the use of postal cars. These rates are for postal cars 3 cts. per mile of actual distance covered, while for a combination baggage and mail car or combined baggage, mail and express car, the rate is only 1½ cts. per mile. At this rate, if a railway company leased a 55-ft. postal car from another company and ran it daily for a year on a postal route 200 miles long, it would pay a rental to the company owning the car of $200 \times 365 \times 3$ cts. = $1,890, and would receive from the Government the sum of $40 \times 200 = $8,000.

It will not be seriously contended, we are sure, that these standard rates of car rental fixed by the railway companies themselves are not fairly compensatory. The 3-ct. a mile rate, if a car makes a reasonable annual mileage, will give the owner of the car a very profitable return on his investment.

Let us look at the railway mail pay from another point of view. In the year ending June 30, 1910, the total payments to railways for carrying the mails was in round numbers 50 million dollars. Besides this there was paid nearly 7 million dollars for carrying mails on "star routes" and over 1½ million dollars for the carriage of mails on steamboats and on electric car lines. This total expenditure of about 58 million dollars for transportation of the mails alone was more than a fourth of the entire expenses of the Postoffice Department. It was in round numbers half as much as was paid as salaries to all the postmasters, assistants and clerks in all the postoffices of the country, all the letter carriers in cities great and small and all the railway mail clerks.

It seems to us that this comparison is one which should appeal especially to engineers. Here is a vast volume of material, made up of pieces weighing from less than an ounce to a maximum of 4 lbs., but averaging probably only three ounces or so in weight. All this matter has to be collected from a wide area, sorted and resorted again and again, packed into bags and unpacked and finally distributed and delivered to residents in cities or to many thousands of country postoffices. All this work, moreover, is done by highly paid workers, with a short-hour workday. Compare now the expense of this with the expense to the railway companies of hauling the bags of mail from one railway station to another!

However, as we have already said in these pages, it will be impossible to ever settle the question definitely as to the fairness of railway mail pay, so long as the weight of mails carried is made the basis of payment.

As proof of this, it is noteworthy that the Postoffice Department committee and the committee of railway officers which is now investigating the question of railway mail pay abandoned at once the weight of mail carried as a basis, and adopted instead the basis of the space furnished in cars for postal purposes.

The abuses which have grown up as a result of the arbitrary weight standard of payment need only be mentioned. Some of our readers will remember the published statements that during the months when railway mail is weighed, the country newspapers, which are carried free by the Postoffice Department, experience a sudden and phenomenal increase in their circulation.

The railways ought to be paid what it actually costs them in operating expenses to carry the mails plus a fair percentage for profit. It is not difficult to closely approximate the cost to the railways of furnishing and hauling postal cars or parts of cars used for postal purposes. The operating expenses per passenger train mile and per passenger car mile are a matter of record by every railway company, and it would not be difficult to deduct from these the expenses for passenger service proper, which do not enter into the cost of hauling postal cars. Of course due allowance should be made for such space as is used by postal cars or for the postal business in expensive city terminals.

Having ascertained the true operating expenses of the railway per postal car mile, it would be fair to add to this amount a percentage equal to the percentage by which the railway company's gross earnings from its freight and passenger business exceed its operating expenses.

Such a method of railway mail pay would give the railways the same rate of profit on carrying the mails that they can earn on the other business. They ought to have this; but there is no reason whatever why they should be paid a higher price.

More than this, such a system of rail[way] mail pay would proportion the expense of tra[nsporting] the mails to the cost of this transport[ation]. It would open the door for large economi[es by the] transport of second-class and fourth-cl[ass] mails over the trunk routes in full train loads [at] a low cost per ton mile.

This is not alone important with r[egard] to the economical distribution of publicati[ons]. The establishment of an efficient and economic [parcel] post system, such as other civilized c[ountries] have enjoyed for many years, cannot [much] longer be postponed in the United Stat[es]. For handling the parcels post system econo[mically,] it is essential that railway mail pay [be pro]portioned to the cost of service. The [De]partment will then no longer load upon the r[ail]ways extra burdens for which no added comp[ensation] is received. Instead it will have an ince[ntive to] so arrange the mail service that it may [be car]ried on at the minimum cost.

The Threatened Disintegration of the Passaic Valley Sewerage District.

It is now more than fifteen years since the first definite steps were taken to free the lower Passaic River from gross sewage pollution. Although a half dozen State Commissions have been created to deal with the problem, nothing has yet been accomplished except to make, unmake and remake administrative and engineering plans. To-day there seems less certainty of speedy construction of disposal works than when the Passaic Valley Sewerage District was created, eight years ago. In fact, the district has already begun to disintegrate—if anything can go to pieces which never cohered. The only thing which can unite the district will be radical changes, designed to put it in on a sounder administrative, financial and engineering basis than now exists. We are not sure that this is possible, or even wise, so changed are the governing conditions from those which prevailed in the earlier years of this project.

The story of this fifteen years involves so many local, state and national complications and so many changes in administrative, financial and engineering plans that its telling would fill a good-sized volume. Perhaps a fair understanding of its leading features may be given under four heads: (1) Departure from the principles of representative government in the arbitrary manner in which it has been sought to compel the twenty communities to unite in a joint scheme of sewage disposal; (2) unfair basis proposed for apportioning the cost between the communities; (3) litigation with New York State and the United States; (4) changed conditions due to increased knowledge of sewage disposal and stream pollution since 1895, and even since 1903, when the second engineering scheme was worked out. Before taking up these features, it may be well to give a general idea of the Passaic Valley Sewerage District and of the latest plans for the disposal of the sewage of the District.

The District comprises some twenty communities located in four counties of New Jersey, as given in the accompanying table. Broadly speaking, the District includes the whole of the lower Passaic Valley from Paterson to Newark. The various plans for disposal have been consistent in always including a trunk sewer along the lower Passaic to serve the whole District, and this sewer terminates at Newark Bay at such a level as to make pumping necessary.

It was first proposed to pump the sewage directly into Newark Bay in accordance with recommendations made by the late Alphonse Fteley and Chas. E. A. Jacobsen. When these plans were made, some ten years ago, it was estimated that the waters of the Bay would afford a dilution of 300 times in 1910 and 100 times in 1930. This plan was defeated by the opposition of the city of Bayonne, which is located on the opposite side of the Bay, combined with opposition from various other sources which cannot be detailed here.

The next plans formulated (and the execution of these plans was authorized by state legislation) involved sewage disposal into New York Bay, practically with no further purification than

screen... and a slight period of sedimentation. Litigat... started by the State of New York and joined ... by the United States, which will be mentio... later, resulted in a further change of plans ... that it is now proposed to increase both the an... of screening and sedimentation. Some of the ... details of the plans and some of the other ...nges which have been made from time to tim... ll be mentioned as we progress.

(1) ... wing a season of unusually low water in 1895, ... consequent nuisance because of the very ... llution of the sewage discharged into the Pa... River, a conference was held at the city of ...ssaic late in the year named to consider ne...sures of relief. The meeting decided that an ...peal should be made to the legislature to give the State Board of Health power and funds to investigate and report the best means of cleaning up the river. This was substantially in accord with what had been done only a few years be...re in the case of the Massachusetts Metropolitan District.

A committee was appointed to secure the necessary legislation, and, as a matter of political expediency, a majority of the committee drew a bill which entrusted the proposed investigation to a special committee of three, instead of to the State Board of Health. This change was never reported for approval or disapproval by the body that created the committee, and the bill became a law.

From that day to this the people in the lower Passaic drainage district have never been permitted to select any of the half dozen commissions created to deal with the Passaic Valley sewerage problem. All the commissions have been imposed upon the district by the State. Moreover, the State has not been content merely to say to the several municipalities, "you must stop polluting the Passaic River," but it has attempted either to dictate the measures to be undertaken or to leave the choice to a State-appointed commission.

True, as will be shown later, some choice was left to the cities and towns in the new legislation of 1907; but that was forced from the then-existing commission and the legislature by the highest court of the State. Even with this concession, the amended legislation goes as far as possible towards forcing the communities involved to adopt the plans of the State-created commission. And if the communities do so elect, then they will be subjected to a grossly unscientific and unfair basis of distributing the cost of the trunk sewer and sewage disposal works.

The normal way to have handled this problem would have been to entrust preliminary investigations to the State Board of Health, in accordance with the action of the Passaic meeting of 1895. Instead, a series of special commissions was first appointed, and later a State Sewerage Commission was created to consider the pollution of the waters of the whole State, as well as those of the Passaic. This State commission was not left long in charge of the Passaic problem, for when the Passaic Valley Sewerage Commission was created, in 1902, it was given jurisdiction over the Passaic. Later still, to leave no doubt as to the right of the State Sewerage Commission to interfere, a special act of the legislature was passed exempting the Passaic from the control of the State commission.

The State Sewerage Commission has since been consolidated with the State Board of Health, and the latter now has sweeping powers of control over the pollution of all the waters of the State, except those of the Passaic. The wisdom of this exception has always been questionable, and has been all the more questionable since legislation passed in 1907 gave the several municipalities the choice between contracting with the Passaic Valley Sewerage Commission for sewage disposal and constructing independent works. For at least by implication, any municipality deciding to build independent sewage disposal works would still be under the jurisdiction of the Passaic Valley Sewerage Commission, instead of the State Board of Health, in case it proposed to discharge its effluent into the Passaic River or its tributaries. Under what jurisdiction it would fall if the effluent was to be discharged into the waters of another drainage area we will not pretend to say.

The significant point for the purposes of this discussion is that if any of these communities sees fit to dispose of its sewage independently, it should then be free from even the jurisdiction of the Passaic Valley Sewerage Commission; or else that commission itself should be subject to the State Board of Health—as perhaps it ought to have been from the start.

It should be understood that we recognize the importance and necessity of State control of sewage disposal, but consider that the interests of the State within the Passaic Valley District, on the one hand, and the rights of the municipalities within that district, on the other, should be guaranteed by the State Board of Health.

In view of all the departures from representative government already brought out and to be still further elaborated in a moment, it is not strange that some of the cities and towns in the lower Passaic Valley have opposed the construction of the proposed trunk sewer and disposal works from the start, and that these or others are taking active steps to build independent works, now that they have the option of doing so.

(2) Let us now consider the unfair basis of apportioning the cost of the proposed sewage disposal works. From the outset, the plan of apportionment has been to divide the cost of construction between the several cities and towns in proportion to their assessed valuation and to distribute maintenance and operating expenses in proportion to use. In the first instance the District Commission was to determine these costs, issue bonds to meet construction charges and report to the tax assessors of the various municipalities the sums of money which the latter would be required to raise to meet capital charges and operating expenses. The municipalities were given no right to approve or disapprove either the engineering plans or the apportionment of cost.

In a lawsuit brought by the City of Paterson, which had consistently opposed the District sewerage plan from the start, the highest court of New Jersey declared the act establishing the Passaic Valley Sewerage Commission illegal on the ground that the act constituted an unlawful delegation of the powers of taxation to the Sewerage Commission, in that neither the sewerage district nor the taxation area (which were different) were political divisions of the State.

The court declared that under the fundamental law of the State of New Jersey "the district to be taxed shall be coterminous with a district with which some right of local self-government is given." In the face of this decision it was deemed necessary to pass a new enabling act.

Although this litigation was begun in 1903 and the decision was handed down in 1905, it was not until 1907 that a new act was passed. This delay was due to the city of Paterson, which sought and was given time to employ an expert to investigate the feasibility of independent sewage disposal works for that city.

The act of 1907 met the court ruling just mentioned by giving each city the right to contract with the commission or not and by providing that sewerage bonds should be issued by each municipality instead of by the District. The basis of apportionment of cost was left unchanged, but it was provided that the apportionment should be based on the assessed valuation of 1907. No provision was inserted in the act for adjusting any inequalities in the cost-distribution that might fall on the several municipalities through changes in growth, valuation or use of the sewers. The unequal distribution of cost thus effected may be seen by the accompanying table, which shows the assessed valuation of each city, with its proportionate share of the cost and capacity of the proposed sewage disposal works. These proportions are shown both by totals and by percentages, and to make the disparity between the apportionments of cost and capacity more evident a column showing the ratios between the two is given. To put the matter more concretely, the final column of the table shows the cost apportioned to each community in units of allotted capacity.

It will be noted that the percentage ratios range from 0.558 for East Orange to 21.7 for North Arlington. In other words, East Orange would pay towards construction cost at the rate of $66,000 per million gallons of allotted capacity, while North Arlington would pay only $1,720; or East Orange would pay 39 times as much per unit capacity as would North Arlington. While this is the extreme instance of disparity between allotted cost and allotted capacity, yet many other communities would have grossly unequal burdens imposed upon them.

It takes little thought to see that no such disparities as run through the table would occur under an apportionment made by common agreement, or in accordance with principles well understood by engineers. Such an apportionment is obviously the result of force, real or attempted, and is bound to give rise to resistance as long as resistance is possible.

It so happens that a few years before the Passaic Valley agitation began, Orange, Montclair and Bloomfield constructed a joint outlet to the Passic River by common agreement, and paid pro rata according to capacity. Considerably later a large sewerage district lying to the south of the Passaic District entered into a voluntary

DISTRIBUTION OF CONSTRUCTION COST AND VOLUME, PASSAIC VALLEY TRUNK SEWER AND SEWAGE DISPOSAL WORKS, BETWEEN THE VARIOUS MUNICIPALITIES CONCERNED.

Col. 1.	Col. 2.	Col. 3.	Col. 4.	Col. 5.	Col. 6.	Col. 7.	Col. 8.
		Apportionment to each municipality.					
		Cost of construction.		Ultimate capacity.		Ratio of % capacity to % cost, Col. 6 / Col. 4	Approx. cost for capacity, 1,000,000 gals. per day, as allotted.
	Net valuations taxable in 1907 in district.	Actual.	Per cent.	Actual.	Per cent.*		
Essex County:							
Newark	$287,508,983	$6,361,996	51.934	98,852,000	29.717	0.572	$64,360
Orange	22,166,600	490,502	4.004	11,672,000	3.509	0.876	42,020
East Orange	40,188,850	889,299	7.260	13,475,000	4.051	0.558	66,000
Bloomfield	7,913,749	175,115	1.430	11,600,500	3.487	2.44	15,100
Glen Ridge	4,245,000	93,933	0.767	3,154,000	0.948	1.24	29,780
Montclair	26,915,100	595,577	4.862	11,821,000	3.554	0.731	50,380
Belleville	5,489,692	121,476	0.992	11,843,000	3.560	3.59	10,260
Nutley	4,152,803	91,893	0.750	10,645,000	3.200	4.27	8,630
Passaic County:							
Paterson	90,764,011	2,008,425	16.395	63,952,300	19.235	1.17	31,410
†Passaic	26,842,714	593,975	4.849	29,194,000	8.776	1.81	20,340
†Acquackanonk	5,398,250	119,432	0.975	19,088,000	5.739	5.88	6,260
Bergen County:							
‡Garfield	1,888,579	41,790	0.341	7,213,000	2.168	6.36	5,790
‡Wallington	581,699	12,872	0.105	5,607,000	1.686	16.1	2,300
‡East Rutherford	388,189	8,590	0.070	2,756,000	0.829	11.8	3,120
‡Rutherford	1,699,265	36,937	0.302	3,256,000	0.979	3.24	11,340
‡Union	1,002,109	22,175	0.181	4,146,000	1.246	6.89	5,350
‡North Arlington	145,412	3,218	0.026	1,876,000	0.564	21.7	1,720
Hudson County:							
Kearny	13,294,000	294,170	2.401	12,894,100	3.876	1.61	22,810
Harrison	9,823,455	217,373	1.775	8,349,300	2.510	1.41	26,040
East Newark	3,219,000	71,230	0.581	1,218,500	0.366	0.630	54,450
	$353,597,460	$12,249,998	100.000	332,617,700	100.000	.....	$36,830
Municipalities outside of the legal district				24,752,500	7.44 (Reserve)		
				357,365,200			

*Based on total allotted capacity of 332,617,700 gals., and not on actual total capacity of sewers.
†Part of the sewage would have to be pumped into the trunk sewer.
‡All the sewage would have to be pumped into the trunk sewer.
Columns 2, 3 and 5 are from the 1908 report of the Passaic Valley Sewerage Commission.

agreement and built a joint outlet to Kill von Kill, also paying pro rata according to both allotted capacity and *extra length of sewer required* for each municipality.

The reference to the Orange-Montclair outlet and the words in italics bring to mind a still further injustice in the distribution of the cost of the Passaic District works. Although a number of the communities in the Passaic District have gone to large expense to construct outlets to the Passaic River, the plans of the commission provide for what are virtually local sewers for a number of municipalities, and also for the construction of two local pumping stations, all at the expense of the district as a whole. This greatly favors Paterson and various other municipalities. Another sop to Paterson is a provision in the 1907 act to the effect that if Paterson comes into the district sewer it will be allowed $25,000 for its local studies and plans of 1906.

Why, it may be asked, this unreasonable way of distributing the first cost of the proposed sewage disposal works for the Passaic District? Since the first step taken by the engineers in designing a joint sewerage system is to determine the volume of sewage to be contributed by each municipality, why not apportion the cost on the same basis? The answer is that while engineers draw plans and make estimates for sewers, lawyers draw legislative acts which establish methods of meeting and distributing costs, and it appears that not many lawyers have yet grasped the fundamental principles of sewerage design as related to the apportionment of sewerage cost. Moreover, lawyers are prone to make a god of precedent and honor and obey it ever afterwards. They seem to regard the canon of general taxation, "each individual should pay according to his ability," as a precedent for distributing the burdens of a joint sewerage system. This canon does not hold as regards joint sewerage works, where the rule of ownership-capacity may well be applied to first cost and actual use to operating charges, with possible adjustments to meet peculiar local conditions.

As we have already intimated, this basis of apportioning first cost is all the more unjust because it rests upon the assessed valuations of 1907, with no provision for future readjustments. In fact, readjustments would involve difficulties in view of the fact that each municipality has to issue its pro rata share of bonds, so that even if provision were made for redistributing interest and sinking-fund charges at some future time, the several municipalities would not thereby be free from the heavy bonded indebtedness which the large cost of the proposed sewerage works will entail. While, of course, it was not foreseen in 1907, the financial plan adopted is made all the worse because four years has elapsed since the law was enacted and actual construction has not yet begun nor any definite provision been made for the issuance of bonds.

We have already referred to the very different basis of distributing the cost of joint sewerage systems established when freedom of contract between several municipalities is permitted. It will be interesting to see what has been done in another state, where various municipalities have been formed into a joint sewerage district at state dictation. This occurred in Massachusetts, but under quite different circumstances. Elsewhere in this issue we give an account of the method of apportioning cost among the various municipalities composing the Massachusetts Metropolitan Sewerage District. It is perhaps worth while to interject that the general scheme of these sewerage systems was formulated by the Massachusetts State Board of Health.

When, in 1889, the Massachusetts Legislature created the district and established a commission to build works in accordance with the general recommendations of the Board, it did not attempt to lay down any rule whatever for apportioning the cost of the sewerage systems. Instead, it provided that a commission of three should be appointed every five years to settle this matter. The commission was given absolute discretion as to the basis of apportionment, *after giving every municipality a public hearing.* In fact, the Legislature even went so far as to suggest modifications in apportionment which should take into account various differences peculiar to the different municipalities.

It so happens that the first apportionment commission adopted the very plan which was subsequently inserted in the act creating the Passaic Valley Sewerage District Commission; or perhaps we should say that in drafting the act just named the Massachusetts precedent was followed. This, however, does not justify the responsible authorities in either state. The facts are that the first Massachusetts apportionment commission was composed of lawyers and that the successive commissioners were also members of the legal profession. Moreover, the lawyers on the first commission were chosen with particular regard to their high standing in the legal profession, and this doubtless heightened the usual deference paid by lawyers to precedent, so that each succeeding commission more or less automatically adopted the plan of the first, until finally the plan was established by statute. It should be noted, however, that the first commission reported that it had taken various local conditions into account in adjusting the assessment; also that interest and sinking fund charges were made lighter in the earlier years and heavier as time went on and population and wealth increased. Furthermore, the State of Massachusetts issued the bonds and merely called upon the several municipalities for capital charges.

As the article on the Massachusetts apportionment shows, the valuation apportionment plan has borne unequally on the several communities involved, and some have protested against it. Unfortunately, the article does not contain a comparison of the results in Massachusetts under the valuation plan as compared with what they would have been under the benefit or amount-of-use plan. It may be added that the latter plan would be complicated in the Boston metropolitan district by the fact that many of the communities have combined and others separate sewers.

It will be seen by referring to the article which we have already mentioned that after a lapse of some years the apportionment commissioners appointed to distribute the cost of the Massachusetts Metropolitan Park and water system have departed materially from the precedent set by the sewerage apportionment commissioners, and that in the latest apportionment of the cost of the Water System considerable prominence is given to use as a basis of apportionment.

So long as the several municipalities in the Passaic Sewerage District were forced to become tributary to the proposed sewerage scheme, whether they wished to or not, they could do little but protest against the unfair method of apportioning cost, but the new legislation of 1907, as we have already seen, leaves it optional with them whether they will contract with the District Commission for sewage disposal works or build works on their own account. This option at once throws into high relief the disparity in distribution of cost, and naturally is a great encouragement for those communities which have high assessed valuations to build independent works. As a result, East Orange and Montclair and several other communities have had under consideration for some months past the matter of building joint sewage disposal works.*

They have also recently caused to be introduced into the legislature a bill amending the district sewerage act so as to distribute interest and sinking-fund charges between the various communities in the district according to volume of sewage contributed. The amendment, however, does not disturb the provision that each municipality must issue bonds to raise money for the work in proportion to its assessed valuation. Accordingly, even if the amendment is passed, some of the communities may be called upon to issue hundreds of thousands of dollars of bonds beyond their proper share, and this may be burdensome even though the interest and sinking fund charges on the excess bonds do not fall upon these communities.

(3) Probably some of the communities in the Passaic Valley Sewerage District would have stirred themselves in the matter of independent works at an earlier date had it not been for the fact that definite steps toward the construction of the trunk sewer and the issuance of bonds were necessarily postponed through outside litigation. Years ago, opposition to the proposed discharge of Passaic Valley sewage into New York Bay on the part of a few very active citizens of New York City. A series of investigating commissions were created by New York State with the object of looking into this matter, and these commissions early took a pronounced stand against the Passaic Valley disposal plan.

Partly as a result of this opposition, the State of New York began an injunction suit in the United States Court to prevent the discharge of Passaic Valley sewage into New York Bay. Soon after the United States intervened in the suit. Efforts to compromise were made between the Passaic Valley Sewerage Commission and the United States authorities. These efforts resulted in an agreement on the part of the commission to establish purification works of a specified character and to guarantee specified purification results. Accordingly, the United States intervention was withdrawn. It was generally understood that the New York State suit would be withdrawn also, but so far as we know it is still pending.

When the compromise with the United States authorities was effected, the Metropolitan Sewerage Commission of New York, which, with its predecessors, as we have already stated, has consistently opposed the discharge of Passaic Valley sewage into New York Bay, urged the New York City authorities to take a hand in the litigation, and failing that to seek an injunction on its own account against the discharge of Passaic Valley sewage into New York Bay. A petition for intervention was subsequently brought by New York City, but has been denied by the United States courts. The possibility of an independent injunction suit, therefore, is still hanging over the Passaic Valley Sewerage Commission.

The compromise agreement with the United States calls for added burdens upon the Passaic Valley Sewerage District, both in the way of first cost of purification works and of operation. Just how burdensome the terms of the compromise agreement may prove to be remains to be seen. Certain it is that elements are introduced in the way of sewage treatment requirements which may give rise to serious complications.

(4) The facts in the matter are that between the purification requirements of the compromise agreement and a variety of changes in both the theory and practice of sewage treatment during the fifteen years since the agitation for freeing the Passaic River from pollution began an entirely different face has been put upon the Passaic Valley sewage problem.

It was originally supposed that no purification would be necessary and that the outfall sewer might terminate at Newark Bay. After plans to this effect were proposed, it became necessary or expedient to change them and to carry the outlet five miles further so as to give a discharge into the large volume of water of New York Bay. It was supposed that this extension to the larger body of diluting water would make it still possible to get along substantially without purification. The recent developments just outlined have made a material amount of purification necessary and no one knows what additional purification may be required by the time the litigation now in process, or threatened, is brought to conclusion.

The chief justification for the lengthy trunk outfall sewer at the outset was the belief that by going to this heavy expenditure the several municipalities forming the district could avoid the necessity of purifying their sewage. In other words, it was thought that the high capital charges on the costly trunk sewer would be less than the combined cost of capital charges and operating expenses on the considerable number of independent sewage works; but with every increase in the length and cost of the trunk sewer and with the various additions to the purification requirements, increasingly serious questions ha

*East Orange has secured a report on such works and on joint works for itself, Montclair, etc., from Mr. Harrison P. Eddy, M. Am. Soc. C. E. The report is favorable to independent works.

arisen in the councils of the various municipalities as to the advisability of their joining in the trunk sewerage scheme.

It was on this account, as already stated, that Paterson secured virtually two years of delay in rectifying the unconstitutional provisions of the sewerage commission act. The independent expert investigation made for Paterson by Mr. Allen Hazen, M. Am. Soc. C. E., led to an endorsement of his part of the trunk sewer scheme only on the condition that there should prove to be no litigation with jurisdictions outside of New Jersey, and that no substantial degree of purification would be required. Both these prohibiting conditions, as we have seen, have arisen, so the logical conclusion would be, at least until further investigations have been made, that it would be wise for Paterson to build independent works.

Besides the changed conditions regarding purification requirements and the possibilities of further litigation, there have been increases in the cost of both labor and materials since the estimates of 1907-8 were made. Although these may be partly offset by material savings, which we understand the Commission expects to effect by changes in the trunk sewer and outlet tunnel, yet it is only reasonable to suppose that the final gross cost of the trunk outlet sewer and the sewage disposal works will materially exceed the 1907-8 estimate of $12,250,000. This, of course, is an added reason for the various municipalities taking into serious consideration the establishment of independent disposal works.

It seems to us very likely that if a competent commission were to start in to-day to investigate the Passaic Valley sewerage problem de novo it might arrive at a very different plan of sewage disposal than that now contemplated by the present commission. Whether this would involve a number of independent plants or a single plant at Newark Bay, with a sufficient degree of purification to enable the effluent to be discharged at that point, and thus avoid the expense of a five-mile tunnel to New York Bay and the interstate complications resulting therefrom, we cannot undertake to say. The probabilities of one or the other alternative seem sufficiently great to warrant serious consideration.

The possible warrant for several independent sewage works, even though all constructed by the District Commission, is given interest if not full justification by the way the large German sewerage district, in the Essen section, is now building many independent works (see article on this district and the Imhoff sewage tank, Eng. News, Dec. 1, 1910).

Particularly pertinent to our general discussion is the fact that the commission building these works, though located in what many consider to be an autocratic and bureaucratic country, is a thoroughly representative body, as regards membership chosen by the municipalities composing the joint district.

It is also a notable fact that the cost of the various disposal works in the German district is distributed among the various municipalities, according to (1) responsibility for existing conditions of stream pollution, and (2) benefits to be derived from the improvements.

Under the German district plan, the worst municipal or private offenders in the way of stream pollution may be dealt with first, and those which as yet cause but little pollution, and may be little able to pay heavy sewage disposal charges, may be let alone for a time, though compelled to conform in any work they may undertake.

The adoption of this general principle in the Passaic District would greatly simplify its financial problems, since one of the chief arguments for fixing costs based on assessed valuations has been that the poorer districts could not afford to pay now for works which may be needed to meet their wants thirty or forty years hence.

Such an argument applies particularly to Acquackanonk Township, a large area now having little population or wealth, for which over 20,000,000 gals. of ultimate sewage-works capacity has been provided, but which is to pay, under the present unjust plan, only $119,452 of first cost, or $6,260 per 1,000,000 gals., against East Orange's $889,299 apportionment for less than two-thirds the sewage capacity ($66,000 per 1,000,000 gals.)

Now it so happens that Acquackanonk has no public sewers, and is not yet polluting the Passaic. This suggests that if the major portion of the present pollution were removed from the river a number of the sparsely-populated communities might discharge their sewage into it for years to come with harm to no one if the great trunk sewer project were to give place to independent disposal works, built for minor joint districts or for separate towns.

In fine, improved means of sewage disposal make local works feasible where they would have been out of the question 15 or even 10 or perhaps 5 years ago. Likewise, changed ideas regarding sewage disposal by dilution, and water pollution generally, give the whole Passaic Valley sewage problem a different aspect than the one it bore in 1895.

Naturally, the present commission is loath to give up the plans on which it and its predecessors have bestowed so much effort, but it should be remembered that the commission was created to serve the needs of the district and not the district to save the commission work or apparent loss of dignity. It should also be remembered that only in small part can the commission be blamed for many of the changed conditions which now exist. What it will have to stand blame for is any failure to realize and act upon these changed conditions.

Anyhow, may not the commission be forced to give up its plans, however much it may dislike to do so? It takes no novice in sewerage design to see that if any large municipality or group of municipalities decides to stay out of the joint sewerage scheme the whole plans of the commission will be to a large extent upset. This would, of course, materially affect the cost of any district scheme for whatever remaining municipalities joined with the district. In view of this fact, no given municipality can have any assurance of what its share of a district sewerage and sewage disposal system would be until it is known definitely just what municipalities are to come into the district.

The situation is a most unpleasant one for all concerned. The only hope we can see of retaining the integrity of the district as a whole is for such a readjustment of the basis of distributing cost and of the administration of construction and operation as will make it an object for every community to come into the district, instead of making it a very decided advantage for some of the most important of the communities to stay out. The whole subject needs careful re-study,* and there should be no delay in putting measures on foot for a reconsideration of the whole scheme.

The very least that should be done in the way of re-study is to have (1) the new plans, since 1908, searchingly examined by the best sewage disposal experts in the country; after this has been done, and the plans modified, if need be, then (2) to have new and careful detailed estimates made of the cost of the project under the revised plans. Certainly no prudent city or town council will contract with the commission* on the basis of estimates made over three years ago, when since then labor and material costs have increased, and the plans themselves have been materially altered.

*The law now provides for tripartite contracts between the several municipalities and the commission.

LETTERS TO THE EDITOR.

Licensing Engineers.

Sir: I have read with great interest the various letters from prominent engineers in reference to licensing in the various States and find that the majority concur with the recommendations put forward by the committee of the American Society of Civil Engineers and are opposed to the measure.

As far as I have been able to judge they have been writing from a purely theoretical standpoint, and take as their major premise, that as the profession has various engineering societies, which have a certain standard of admission, that this should be sufficient notification to the public that a man belonging to one or the other of these is competent, trustworthy, and desirable. Therefore a member of such society should be employed.

Theoretically there is nothing to be said against this view but the trouble is that the main supposition is wrong, or rather, the trouble is that, too few people know that any such societies exist at all.

Take the American Society of Civil Engineers. This has a membership of about 5,300 all told. Calling the population of the United States 90 millions; this makes one member to every 17,000 people, and I am sure the majority of that 17,000 have never heard that such a society exists. True, most of the 17,000 would never want to employ an engineer anyway, but taking those who would employ one, or would want a surveyor, very few of these know that this society, or other societies, are on the face of the earth, much less do they know anything about the requirements for admission.

If we could have a law that would necessitate the employment of a member of one of the societies, or if we had a perfect way of getting the knowledge of their existence, aims, objects, and requirements for admission to the general public, then licensing would be superfluous. This would be a Utopian condition, and would not only be greatly beneficial to the societies, to the profession and to the public at large but at the present time it is simply an iridescent dream, and we should deal with actual conditions.

Far be it from me to criticise adversely the societies. They all have done and are doing a wonderful amount of good, both to their members and to the public. But in the nature of things they cannot reach far enough to reach every one. No scientific or professional society has ever done so, because inherently they are organized for the direct benefit of their members. Were this not the case, they would cease to exist or would lose their identity as organized at present.

If we compare engineering with other professions, we find that physicians, lawyers, pharmacists, clergymen and others have organizations similar to our engineering societies, but it will be found that most of the States require that a man should have a license to practice medicine or pharmacy and a man must be admitted to the bar before he can practice law, although I believe in matters heavenly they do not require it. On reflection, it will, I think, be admitted that this licensing is primarily for the benefit of the public; in other words, to protect the public as far as possible from incompetents and charlatans. The pharmacist is licensed so that we will not get poisoned, the physician so that he will not prescribe the wrong medicine, the lawyer so that the client will be properly represented in legal matters, and I suppose that the clergyman is not licensed, simply because everybody thinks he knows more about the clergyman's business than he does himself.

Now, on the face of things, when a law is made it becomes known. It is printed, distributed, promulgated by attorneys and, in fact, circulated in many ways. People get to know it. It spreads of itself to those interested. It is a well known fact that for some years people wanting divorces flocked to Reno, Nevada, a small town in a small State, and also that many trusts incorporated in New Jersey. In both cases people concerned learned the law. It is true, some laws are good and some are bad, but, nevertheless, they get known.

So far this discussion has been theoretical, but with the object of coming to good, plain facts. I live in the State of Wyoming, whose population is about 140,000 people. It is a new State. The inhabitants require a little engineering and a great deal of surveying. Engineering is really the forerunner of civilization and later her handmaiden. Of those 140,000 people I will venture to say that not 1% have ever heard of the great engineering societies, but not less than 20% are well aware of the license law for engineers and surveyors that was passed four years ago at Cheyenne.

This law concerns only those engaged in irrigation work and other work concerning water. Prior to the passage of this law, over 70% of the applications for water rights were returned by the State Engineer for correction. Now there is considerably less than 15%. The effect of the law has been to weed out incompetency and to increase ability. We are not perfect yet but we are improving all the time.

In my own part of the State I have noticed the young surveyors are studying all the time in order to do better work. This refers not only to college graduates, but to those who have picked up what little they know through hard knocks, and who possibly can only manage to run a line of levels and a compass. These last men could not possibly gain admission to any one of the great engineering societies, but we need them here to survey our small ditches, so as to irrigate the lands and improve the country.

An ordinary ranchman could not afford to send 100 miles for a first-class man to run a ditch, which can be surveyed in half a day or so by one of the above. It may be lamentable; but when the ordinary man in this State wants a surveyor, he goes and employs the first man he comes across who has a shingle hung up; and he does not hunt around to see if he has any kind of a diploma either, but lately he makes sure that the man is licensed and so he gets better work than he formerly did.

I have also noticed that this license law has had the effect of stimulating several young men in their studies. I have at present a young man in my office who is a graduate in engineering but was out of engineering work

for a year. Now being desirous of obtaining a high grade license he is studying and reviewing his work so that he can pass an examination for a high grade. I also know of two young men who had low-grade licenses, and were surveying small works, and who studied to pass a grade higher, became interested and are now in college with a view to becoming engineers.

In fact the whole tendency of the law has been to improve the men doing surveying and engineering work and in addition the public has had better work and on the whole it has been done cheaper because it does not have to be done two or three times.

I can also frankly say that formerly I was opposed to any license law, but have changed my opinion.

I also take the position that if a man is a full member of any of the engineering societies he should be granted a license without examination. Such a man has shown once that he is qualified, and that is enough. In fact such men do not need license laws. A man who has attained eminence in any profession must necessarily be a valuable citizen, and we need no laws at all for such as him, or at least very few. But we do need laws to protect the public from quacks, charlatans, incompetents and their like, and we need a license law in Wyoming simply because the people do not know of the great engineering societies, and of the engineering schools and what they teach.

Yours truly,
W. Newbrough, M. Am. Soc. C. E.

Evanston, Wyoming, Feb. 6, 1911.

Sir: There seems to be a sentiment abroad that the profession of civil engineering needs protection from ignorant and vicious pretenders, and that a license to practice is going to afford protection both to engineers and the public. The bill now being considered is admittedly initiative of the physicians' license law. No one will claim for the physicians' law very great efficiency in protecting the public, and there are good reasons why the engineers' law would be still less effective in keeping quacks from practicing.

The engineering profession, as it is very properly described in this bill, is the apotheosis of common sense coupled with knowledge. The common sense must be born in the man; the knowledge may be acquired; but no system of examinations or rules or regulations or licenses will ever determine whether there is enough common sense in a man to make an engineer. It may be possible to get, by examination, an idea of the amount of knowledge a man possesses, but his ability as an engineer can be only known by his work.

Nor can there be drawn a line of demarcation between the mechanic, or the student, and the engineer. The apprentice works out his time, and may then work as a journeyman all his life; or, if he has the energy to acquire knowledge, and the common sense to use with it, he may grow to be an Ericsson. But in the latter event no examining board can say just when he becomes an engineer, and worthy of a license.

Again two graduate students may go into the field, and in four years each may be a transitman in charge of a field party. Each can pass your examining board and get a license, but one may never get beyond a location party in all his life, while the other may build a Pennsylvania Terminal. The license will not make an engineer of the one, but it may hinder the other.

The proposed licensing system undertakes to define where the profession shall begin and how far it may extend. It undertakes to protect the public against imposture, and engineers against each other. Even in this narrow view the licensing system must be ineffective because no examining board can have the omniscience to license only men of engineering ability; neither can it bound the profession with state lines. Any law which prohibits an engineer from practicing in New York because he happens to live in Jersey City is absurd and will prove utterly ineffective.

The American Society of Civil Engineers, by its system of admission to membership, makes every member of the society in honor bound to assist the Board of Direction in preventing any undesirable candidate from being admitted to the society. The Board of Direction devotes a vast amount of time and work in searching the record of a candidate before and after presenting his name to the society for election. There are a few fixed conditions as to age, experience, etc., which must be complied with, but the principal condition for membership is that the candidate shall be of the stuff of which engineers are made, and that he be honest.

All the engineering societies strenuously endeavor, in a similar manner, to keep the unfit from their membership; and yet there is no doubt but that candidates are sometimes admitted who haven't the "common sense coupled with knowledge" required in an engineer.

If then the societies, with all their members on the alert, fail in keeping up their standards, what a complete failure awaits any examining board, which, at occasional formal meetings, shall undertake to decide, among a host of applicants, who is an engineer and who is not?

There will be a host of candidates. All the halt and the blind in the engineering line; all those who need props to hold them up as engineers; all those who have not succeeded in getting into the societies, or who think that a license makes an engineer, will crowd the offices of the examining board. And many of them will get their licenses, because it is simply impossible for any examining board to acquire the knowledge necessary in each individual case, for correctly deciding whether the applicant is an engineer or not. The result will be an absolute and complete failure as to protecting engineers against the competition of quacks.

There will be failure again in raising the profession in public opinion if the law undertakes to protect the licensed engineer. Argue as we may, the public will see in it only an attempt to make a "closed shop" for engineers. The claim that the object of the law is to protect the public from the incompetent will be taken precisely as the old claim of the trade unions that only union men are competent, is taken; and for precisely the same reason, neither claim is true.

A further failure in the law may be expected through the utter impossibility of enforcing it with regard to state boundaries. Suppose the Chief Engineer of the Southern Pacific Ry. were called to New York to consult with its officers there about a few thousand miles of railroad construction. Would this law under which he would be "deemed guilty of a misdemeanor" be enforced against him? Yet the law which gives an exclusive license to practice must prohibit practice without it, and thus present the absurd situation of making every engineer visiting New York guilty of a misdemeanor if he consults with any one about an engineering work, no matter where it is, or if he uses, in connection with his name, any designation tending to imply that he is a practitioner of engineering.

As the practice of engineering is the development and working of natural law, so the profession of engineering has developed and grown up under the action of natural law, and that law seems sufficient for its needs. In the past, the law of natural selection has steadily segregated engineers and drawn them into a profession, which has, by its work alone, forced a certain recognition and appreciation from the world. This appreciation is growing just as fast as the engineer's work grows. Any attempt to put a brand of ownership upon the profession must work toward degradation. You may brand a calf and claim him at the round up as your steer; you may brand a man as an engineer, but the profession will not necessarily claim him.

A. De W. Foote,
M. Am. Soc. C. E.

Grass Valley, California, Feb. 10, 1911.

The Failure of the Henke Building and the Principles of Concrete Design.

Sir: I note in your issue of Jan. 26, 1910, p. 108, a letter by Mr. Edward Godfrey, regarding the wreck of the Henke building at Cleveland, Ohio.

There is much in this letter which the writer would commend. There is one statement which is, however, an injustice to those engaged actively in the reinforced concrete business, as follows:

It is the profession, as represented by its leaders in framing literature and its foremost members in the reinforced concrete field, that is responsible for this wreck and not the individual designer who may have done his utmost in following standard, though abominable, practice.

As a commercial engineer in the field of reinforced concrete construction, the writer makes it a practice to guarantee his designs when they are satisfactorily executed, and as he frequently has bonds outstanding in amounts ranging in the hundreds of thousands of dollars, he believes he may claim to be making good from the commercial and practical standpoint in putting up safe buildings, and to be fairly conversant with the difficulties in putting up such buildings economically with the ordinances and regulations which stand in the way.

The failures and difficulties with reinforced concrete construction are largely traceable to rules and regulations drawn by members of the engineering profession who have had little, if any, experience in the actual construction of this line of work. In other words, those ignorant of concrete construction in the engineering field presume to-day, and have presumed for a considerable time in the past, to dictate the rules and regulations under which those who know how to construct safely and are constructing safely, shall execute their work.

The average municipality calls in those who are lacking in experience in this class of work to frame its rules and regulations. The American Society of Civil Engineers, in appointing a committee to investigate and report on safe rules for the construction of reinforced-concrete buildings, selected a committee, none of whom was actively engaged in reinforced concrete construction and who could be legitimately presumed, from their past experience, to know enough about the business to formulate comprehensive, suitable and safe rules for the fabrication of this class of construction. This being the case, is it not an injustice to the many capable, energetic and intelligent engineers, who are engaged in reinforced concrete construction, to assert that they are responsible for the ignorant rules and regulations adopted by the majority of municipalities, and by the [illegible] of the Committee on Concrete and Reinforced [illegible] of the American Society of Civil Engineers?*

The worst difficulty which is in the way of the constructor in reinforced concrete, is that he [illegible] pected to submit tamely to the regulations dra[illegible] by men ignorant of the first principles of his bu[illegible] that he is expected to work under the handicap of [illegible] tition by men who will comply literally with [illegible] rules and put up the cheapest and most dangerou[illegible] of work that badly drawn rules will permit.

The writer is of the opinion that there is no rep[illegible] engineer or contractor actively engaged in rein[illegible] concrete construction, that does not feel, keenly [illegible] fact that every failure, no matter on what syste[illegible] this class of work, does him personally a ce[illegible] amount of injury. It makes no difference whether [illegible] system failing is in competition with him or not [illegible] injury is none the less real in prejudicing the ge[illegible] public against a type which intelligently designed [illegible] executed, is the safest there is, because it grows str[illegible] as time goes on, and because there is less excuse [illegible] cident during construction since the men at all [illegible] have a solid floor to work on instead of a grid [illegible] steel construction.

Is it not about time that municipalities wake [illegible] to the fact that those actively engaged in the busine[illegible] best qualified to draw up safe and sane rules for [illegible] struction and employ such men to formulate [illegible] building code, instead of going outside of those [illegible] are familiar with the art, bringing in structural [illegible] neers, newspaper editors, brick layers, chemists, [illegible] the like to formulate regulations governing this [illegible] portant industry?

The old code of Cleveland requires more expen[illegible] construction than the requirements of good and [illegible] design demand. Columns designed rigidly in acco[illegible] ance with the Cleveland code, when erected at the chilly season of the year, are indeed dangerous elements. A column which contains vertical steel and little or no hooping, put up at a period when the cement gets chilled and lies dormant, may fail almost without warning, while the same column erected in the warm season of the year would give no trouble whatever. A reasonable building ordinance, which requires the proper proportion of hooping and vertical steel, would prevent a failure of the character of the Henke building, as far as this element of design is concerned, because a slight softening of the concrete during the sweating period could not cause failure without the destruction of the hooping.

In the rules formulated in the Majority Report of the Joint Committee, little or no difference is made in the allowance for the safe and unsafe types of column reinforcement. What more could be expected from men who are not engaged in or reasonably conversant with this line of business?

Mr. Godfrey is to be complimented on his frankness in treating the subject, and yet it seems to the writer that he has not completely covered his views as to the proper type of column. The column with hooping only and without the proper percentage of vertical steel is practically as dangerous as the one which goes to the other extreme, an excess of vertical steel and no hooping.

The relative safety of the various types of reinforced column is not brought out by nursery tests nor by full-size tests of columns fully cured. It is rather brought out by long experience in construction under various conditions under which the concrete cures, such as different temperatures and the like. The Henke building is, as the writer views it, an unfortunate example of the combination of ignorance in design, bad building regulations, unfavorable temperature conditions and the lack of appreciation on the part of the constructor of the proper methods of procedure under unfavorable conditions of temperature.

In Minnesota we are erecting buildings through the coldest winter weather without especial difficulty, suitable precautions being recognized and taken by the contractors executing the work. Accordingly it cannot be urged that concrete is particularly dangerous in the winter season, but it can be and should be urged that it does require intelligent care to secure satisfactory results at this period of the year. While the design of the Henke building is open to severe criticism from the engineering standpoint, as are also the regulations of the city of Cleveland, the writer is inclined to the opinion that the season of the year and lack of appreciation of the proper treatment of the material, concrete, in cold weather is by far the largest factor entering into this unfortunate failure.

Taking up now more specifically the criticism which

*[In justice to the members of this Committee it should be said that this statement is not precisely correct. Of the five members, now living, who signed the majority report, two are engineers directly concerned with the design and supervision of concrete work, two are professors of engineering for many years intimately connected with the testing and design of concrete structures and one is the President of a cement company and the editor of a concrete journal. The late J. W. Schaub, the deceased member of the committee, had long been a designer of concrete bridges and buildings. Had Mr. Turner said that "none of the Committee was actively engaged in the contracting end of concrete building construction," his statement would have been more nearly correct.—Ed. Eng. News.]

the ...ter has made as to the values recommended by the ...t Committee of the American Society of Civil En...rs, and frequently adopted by building depart...throughout the country, he does not hesitate to ...mself on record as follows:

...e considers the values allowed by the majority of ...ing ordinances as too high for safety on plain con... concrete reinforced with vertical steel and with ...small number of ties, and about half as high as is ...ssible with perfect safety for the better types of ...rcement such as the proper percentage of vertical ...l combined with hooping; that in general building ...nances throughout the United States, and the write... nows of no exception to the rule, do not take into ...ideration the advantages of multiple way reinforce...t; that they do not appreciate the added safety involv... in two-way beam construction and two-way slab ...forcement as compared with one-way reinforcement, ...y more than they seem to have appreciated in a goo... any places the necessity of properly combining vertic... reinforcement with hooping in the design of columns.

How ...any more failures it will require to teach this needed lesson no one in the business can say but it may be obs...ved that the successful constructors are adopting th... most conservative types of reinforcement and maintaining a clean record of no failures while the ignorant engineer, who has little or no practical experience, and whose knowledge has been derived from the literature of reinforced concrete, continues to devise dangerous construction and occasionally is unfortunate enough to get into difficulty therewith.

C. A. P. Turner.

Minneapolis, Minn., Feb. 7, 1911.

Notes and Queries.

It is possible that some of our readers who have read the accounts published in Engineering News of the methods adopted for raising the "Maine," may have failed to obtain a clear understanding as to the way the work is being done. For the benefit of any such readers—and the delectation of others—we reprint the following non-technical description from the "Springfield Republican":

The raising of the vessel is being accomplished by the sinking of a series of disk sheet-iron piles that are driven in sections. These piles completely surround the hull of the ship, and dredging is necessary to remove the accumulation of mud in which the vessel now rests. After this work is completed air will be pumped into the piles and their buoyancy will cause the ship to rise. It is well understood by those who are engineering the work that the plan may fail, because there is danger that the ship may break in two, in which event another plan will have to be devised.

In reporting the inquest on the New York Central battery-house explosion, in our issue of Feb. 9, 1911, p. 174, we made only an approximate statement as to the location of the set of pipes involved in the accident. We said (p. 174, col. 2, near foot) that the collision broke four pipes which ran transverse to the track some 2 or 3 ft. behind the southerly columns of the battery-house.

Our attention has been called to the exact figures, which are: Pipes 4 ft. behind front face of columns, or 7 ft. behind the nosing of the concrete protection-pier.

As to the question of what ignited the gas, we said:

Nothing was learned as to what flame, spark or the like might have ignited the gas.

The testimony at the inquest showed that a watchman, who was standing at an open window in an office at the east end of the battery-house, had a cigar in his mouth shortly before the explosion. Two witnesses, one a policeman, had specially noticed his having the cigar and yet were unable to say whether or not it was lighted or had been lighted. If the cigar was being smoked, it could have set off the gas, Prof. Lucke testified. As the watchman was killed by the explosion, his own testimony is not available. He may have been smoking while the two witnesses were with him, or he may have lighted the cigar after they left him. The question is not momentous, however, as it is known that the gas had spread outside the building and any flame, spark or lighted match on the street could have ignited it.

We are requested by Mr. Charles Saville, Kronprinzenstr. 66, Essen-Ruhr, Germany, author of the article on "A Germany Sanitary District and the Imhoff Sewage Purification Tank," (Eng. News, Dec. 1, 1910, p. 604) to correct the statement made on p. 607, of the issue named, to the effect

that 25% of the gases resulting from decomposition of sewage-sludge in the Imhoff tank consists of carbon-monoxide. This is a misstatement which should be corrected. Twenty-five per cent. of the gases in question is carbon dioxide, not carbon monoxide. The remaining 75% of the gases is CH_4, commonly spoken of as "Marsh-gas."

SPHERICAL ROOF.—J. W. Pearl, The Rookery, Chicago, Ill., quotes formulas for a segment of a sphere under uniform external pressure, in answer to the query of A. O. M. (Jan. 26, 1911) concerning a segmental tank roof. Assuming that the plating has a heavily reinforced rim, the shell is to be considered in compression just as in the full sphere, the rim being in tension to give vertical reaction pressure. If v is the rise and r the radius of the segment, the sphere radius R is

$$R = \frac{r^2 + v^2}{2v}$$

The compression in the shell, per lineal inch of meridian section, when the external pressure is p lbs. per sq. in., is $F = \frac{1}{2}\, p\, R$; the tension in the rim is $T = pr(r^2 - r^2)/4v$; and the vertical supporting reaction per lineal inch is $S = \frac{1}{2}\, pr$. He believes that a segmental roof of small rise, under uniform vertical load, may be computed as under uniform radial load, without much error.

Mr. S. M. McMurray, of Dallas, Tex., sends the following suggestion to draftsmen:

It frequently happens that in attempting to erase heavy lines, and especially lettering, one finds that the pen has apparently bitten into the tracing cloth, leaving dark lines and spots that defy all efforts to erase, except by means that destroy the cloth. In this case it will be found that by simply turning the sheet over and applying the eraser to the other side, most of the offending ink can be entirely removed.

The Completion of Government Ownership of the Telephone Business in England.

We noted in the "Personal" columns of our issue of Jan. 19 that Prof. Dugald C. Jackson, of the firm of D. C. & W. B. Jackson, had been retained by the British Government as advisory expert in the valuation of the system of the National Telephone Co., whose property is about to be taken over.

The High Court of Justice in Dec., 1880, ruled that telephone communications were to be classed with telegrams and placed under the government monopoly of the Post Office. The Postmaster General, at that time, decided that it was not feasible to provide an entirely new service for the whole country, and accordingly licenses were granted to various private concerns to carry on the business of furnishing telephone service.

The last of these licenses to expire is that of the National Telephone Co., Ltd. This license was granted in 1884 and ran for 31 years from 1881. Its expiration comes on Dec. 31 of this year. Under this license the National Telephone Co. could furnish any sort of telephone service in the United Kingdom. In 1896, however, the company turned over its trunk line business to the Postoffice. The government paid about $2,300,000 for 14,500 miles of metallic circuit owned by the company.

Since this purchase, the postoffice has carried on all the toll line or long-distance communication in the United Kingdom, and has also established local exchanges in rural districts where the National Telephone Co. did not see fit to provide adequate service.

In 1898, municipal-plant licenses were granted by the Postmaster-General to half a dozen cities, and three such licenses are still outstanding. About this time, the postoffice established exchanges in London and built an expensive underground system of wires in an area of some 640 square miles, comprising the County of London and surrounding districts. In this territory the postoffice and the National Co. are competitors. Agreements have been made by which certain districts, except in the very center of London, are developed by the company and other districts by the postoffice only. The rates charged within the London district have been practically the same under both systems, and the two systems are inter-communicative, so that much of the effect of complete competition is not obtained.

As the date for the termination of the National Telephone Co.'s license came closer, it was necessary for the government to take plans for the purchase of the plant or else for the construction of an entirely new system to take its place. In 1901 an agreement was reached for the purchase of the plant, and in 1905 it was further agreed that the government should be allowed to pay three-quarters of the purchase price at its own option, or, with the consent of the company, the whole purchase price in annuities extending over 20 years. The agreement also contains provisions as to the methods of valuation. These provisions demand appraisal by experts, and for this Prof. Jackson has been retained.

The value of the plant is to be found as on Dec. 31, 1911, and is to exclude any allowance for the past or future profits or any compensation for compulsory sale. The suitability of plant, land, buildings, stores and furniture for the purposes of the postoffice service are to be taken into account. The agreement follows the language of the House of Lords on the interpretation of the Tramway Act of 1870. Under these terms, the price to be paid by the postoffice will amount to such a sum as it would cost to replace the plant on the date of purchase with a post-office plant, diminished by the money expense of the depreciation of the old plant during the time of use. The two problems before the government appraisers then are (1) the present value of the various parts, and (2) the extent to which the valuation may be effected by their fitness for the postoffice service.

Several matters of policy have to be decided at this time as affecting the valuation. For instance, within the City of London, the National Telephone Co. has still a great number of overhead conductors, and it is probable that the post-office would substitute underground cables for these. Such a proposal would greatly decrease the value of the overhead wires. Also, many of the company's instruments are of the old magneto-ringing type, which is being superseded by the central-battery system.

An agreement on the valuation is to be reached between the Postmaster General and the company, if possible. Failing such an agreement, the Railway Commission will act as a Board of Arbitration.

AN ORE DOCK OF REINFORCED CONCRETE is being built at Marquette, Mich., for the Lake Superior & Ishpeming Ry. The bents are 12 ft. apart and each bent consists of four columns. The inner and outer columns on each side are connected by solid vertical webs of concrete, while concrete struts extend laterally between the two inner columns of each bent, and longitudinally between the bents. Concrete girders support the inclined floors of the ore pockets, which floors are lined with a wearing surface of hard maple. The steel reinforcement of the columns forms a self-supporting structure, but is not figured as carrying any part of the load. The dock, or pier, will be 1,260 ft. long, with 200 pockets (100 on each side) and a total storage capacity of 60,000 tons. The height is 75 ft. to the deck, while the height from the water to the hinges of the pocket chutes is 43 ft. The chutes are 35 ft. long; they are counterbalanced and are operated by electric power. The structure has pile and concrete foundations, and the amount of concrete in the foundations and superstructure will aggregate 30,000 cu. yds. The dock was designed by Mr. J. F. Jackson, M. Am. Soc. C. E., of Milwaukee, Wis., in conjunction with Mr. R. C. Young, M. Am. Soc. C. E., Chief Engineer of the railway; Mr. J. E. Greiner, M. Am. Soc. C. E., of Baltimore, Md., is the consulting engineer. The Wisconsin Bridge & Iron Co. has the contract for the steel work, and erection has been commenced. The contract for the concreting of the superstructure has not been let.

A BOARD OF MUNICIPAL RESEARCH AND STATISTICS has been appointed by Mayor Maddox, of Atlanta, Ga., in accordance with an ordinance recently passed by the City Council. The Board consists of three members of the City Council, three citizens and the City Auditor, Mr. Carl Hurst. The duties of the Board are:

To collect statistics of various municipal corporations throughout the United States and foreign countries, and to advise the Mayor and general council as to the statistics of such cities, and of the progress made by other cities in the conduct of municipal affairs that will be of benefit to the city of Atlanta.

The Atlanta Board differs from most of those previously established in that it has been created by the city authorities, instead of being a voluntary private organization, with expenses met by subscription. We are indebted to the New York Bureau of Municipal Research for the following list of bureaus established to date, including dates of incorporation:

Name.	Date.
Bureau of Municipal Research, New York City, N. Y.	1906
Bureau of Municipal Research, Philadelphia, Pa.	1908
Bureau of Municipal Research, Cincinnati, Ohio	1909
Bureau of Municipal Research, Memphis, Tenn.	1909
Bureau of Municipal Research, Ft. Wayne, Ind.	1910
Bureau of Municipal Research, Westchester, N. Y.	1910
R. L. Stevens Fund for Municipal Research, Hoboken, N. J.	1910
Bureau of Public Efficiency, Chicago, Ill.	1910

The above bureaus are supported entirely by voluntary contributions.

In Boston there is a Bureau of Municipal Research, established in 1910, as a division of the Finance Commission [a state-appointed commission, created in accordance with recent charter amendments.—Ed.]

In the following cities there are Bureaus of Municipal Research established as a part of the city government: Baltimore, Md., 1909; Atlanta, Ga., 1910 [the subject of the main part of this note.—Ed.]; St. Paul, Minn., 1910.

Further Notes on the Collapse of the Henke Reinforced-Concrete Building.

By ALEXIS SAURBREY.*

The Henke Building, situated at Lorain Ave. and West 30th St., Cleveland, Ohio, collapsed at about 7 p. m., Nov. 22, 1910.† The following day the owner appointed the firm of which the writer is a member to investigate and report upon the collapse, and to act as technical counsel to his attorneys. The following is an account of the result of this examination, based upon personal inspection of the ruins, and upon the testimony given before the Commission appointed by the Director of Public Safety, Mr. F. G. Hogen.

This Commission submitted a report which has been published in Engineering News,‡ but this

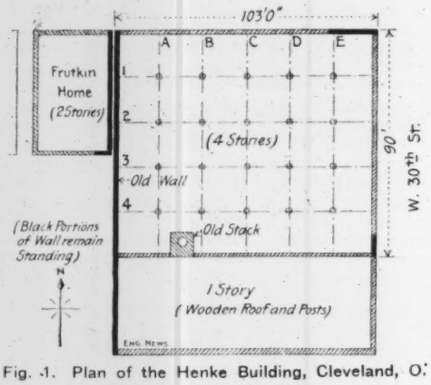

Fig. 1. Plan of the Henke Building, Cleveland, O. Collapsed Nov. 22, 1910.

(Reprinted from Engineering News, Dec. 8, 1910, p. 637.)

report deals principally with the findings of the Commission, and less so with the details of the investigation. The Commission examined very fully into every detail of construction and erection, as was evident to any one present at the meetings. Its position was unique, as it had no power to call witnesses, so that all testimony was given voluntarily and by invitation, without the solemnity of the oath. The several parties involved were represented at the public meetings of the Commission by attorneys, but no cross-examination of witnesses was allowed, nor did the Commission hear evidence given for or against certain particular theories and claims, such as would have been the case in court proceedings.

The collapsed building was about 90 × 107 ft. in plan (Fig. 1), four stories high above the curb, and with a basement below the street level. The design called for brick bearing walls with interior construction of reinforced concrete, the columns and girders being of the ordinary type used for such buildings, while the flat portion of the floors and roof was built of a combination of hollow tile and reinforced concrete, the tiles being 8 × 12 × 12 ins., and the ribs 4 ins. wide, with a top coat over the tiles 2 ins. thick on the floors and 1-in. thick on the roof. Fig. 2 shows the construction of the various elements.

Bids were taken on plans showing mill construction. Reinforced concrete was later substituted, and it developed during the hearing that no plans of the reinforced-concrete work were in existence when the contract was signed. The contractor agreed to furnish plans satisfactory to the architects and to an engineer to be appointed by them. It is not necessary to follow here in detail the circuitous route traveled by these plans in their preparation and final acceptance; it is sufficient to say that they did not suffer from want of attention. Quite likely, different opinions may exist as to the excellence of the design, and exception may perhaps be taken to certain particulars, but, as shall be shown below, the collapse was not a direct result of any inherent weakness in the design.

More particularly, the collapse was not a direct result of faulty column design, as has been maintained in some published criticism. This follows from the fact that all of the columns in the first story were left standing. In these columns the percentage of reinforcement was greater than in any other part of the building, and therefore faulty design would have made itself manifest here if it had existed, the ratio between calculated and actual loads being nearly the same in all stories except in the roof story, where the shoring was practically intact when the building fell. Several columns of the second story are standing. The columns which suffered the most are in the third story, and all indications point, indeed, to a column failure in this latter story, due, probably, to some fatal error in the concreting. To this reference is made below; it is sufficient here to point out that the unreinforced concrete, if well made, would not have been stressed in excess of the allowable stresses in any case, under the loads actually in the building when it fell, and that in one case, the hoops were spaced as much as 42 ins. apart, without any apparent trouble. The writer does not wish to be misunderstood as advocating the omission of hoops, or even the great spacing of hoops as sometimes used, but he is here endeavoring to state the facts as he found them.

The work of erecting the building was started a few days before the contract was signed. The contract called for the entire building to be delivered complete (except heating, plumbing and lighting) on Nov. 10, leaving an interval of about 90 working days in which to erect footings, four reinforced-concrete floors and the roof, also of reinforced concrete, remove all shoring, complete plastering, glazing, painting, wood and cement floor finish. This, however, was not even approximately accomplished, for when the building collapsed on Nov. 22, the shoring of the top (fourth) story was still practically intact and in place, supporting the concrete of the roof, of which latter the structural parts had been completed about Nov. 10, while the saddles for the drainage were concreted on the day of the collapse. In the third story, a few 4 × 4-in. shores were said to be in place, viz.: one shore under the middle of each girder, and a row of shores under the middle of each slab panel. The distance between these shores was about 7 ft. Preparations had been made for starting the plaster work in the third story, but no plaster had been put on there. The work done on the last day consisted principally in concreting on the roof to form the saddles, and in filling ballast between the sleepers for the wood floor in the third story; this latter for a couple of hours only before quitting time.

It is possible that the shores referred to in the third story were disturbed on the afternoon of the 22d, but the witnesses all maintained that such was not the case, and that no work [illegible] kind had been done on the shoring since Friday preceding the collapse, or about [illegible] days. Nobody, it appears, had observed any [illegible] of weakness or trouble, except that a pl[illegible] later remembered that his scaffold moved during the afternoon without apparent cause. [illegible] five minutes before the collapse the two watchmen made their prescribed rounds [illegible] first story and then went to their shanty in the southeast corner of the lot, about 10 or [illegible] from the building. They had observed n[illegible] to make them uneasy in any way.

At the time of the collapse, no heavy or concentrated loads existed in any part of the building except in the first story where three or four carloads of crated furniture were stored, such as chairs, tables and other bulky matter. No cyclone or earthquake was noticed, and there has been no evidence, nor in fact any suspicion, that anybody had reasons for committing acts of violence or crime. Union labor was specified and apparently employed.

Twelve or more witnesses either heard or saw the collapse. They all testified to practically the same sequence of events. It was the sum of the evidence given that no explosion occurred; that there was considerable noise in the building before the collapse actually took place, that the fourth floor was precipitated upon the third floor at the northeast corner of the building, and that probably this was the first piece which fell; that the collapse ended with the fall of the east, north and west walls in the order named (it has not been established just when the parts of the south wall fell, and that the entire time consumed was very short, not more than two minutes at the most, while some witnesses estimated the time at much less.

The writer had no opportunity to examine the ruins until about 2 p. m. the following day. At that time the streets had been cleared of the larger part of the debris, and it has been found impossible to establish where many pieces fell. Parts of the walls were standing, as shown by Fig. 6; these walls, as well as the large chimney, were torn down during the following days. It could, however, be established that the roof had fallen down almost straight and undisturbed so that it covered the entire lot, each part remaining in its original position with reference to adjoining parts. Numerous holes have since been dug down into the debris by carpenters digging for their lost tools, and for examination purposes, and in all cases the several floors were found on top of one another in their natural order, girder above girder and slab above slab, with variations not exceeding 24 ins. The brick walls fell on top of the concrete; the spread of the walls was slight except on the north and west sides, where parts of the walls fell out 30 ft. or so. The

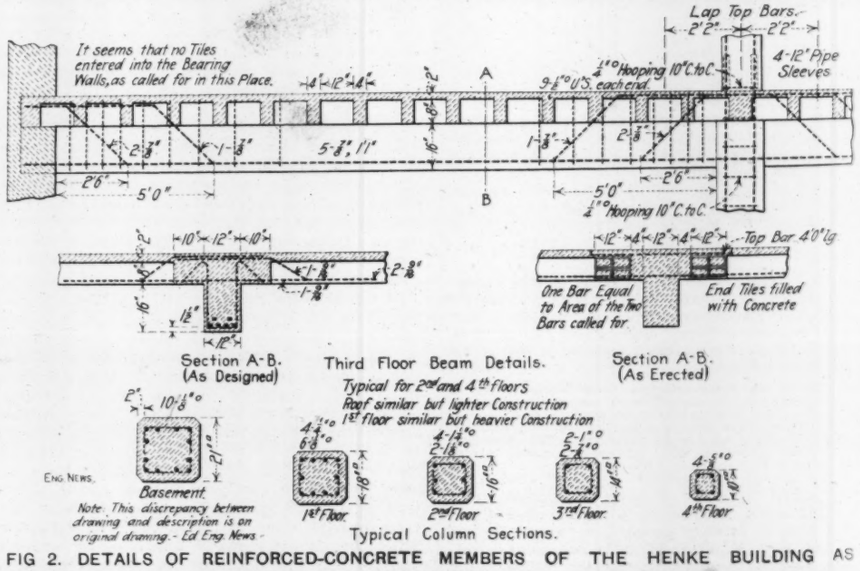
Lap Top Bars.
2'2"
2'2"
It seems that no Tiles entered into the Bearing Walls, as called for in this Place.
4-12" Pipe Sleeves
1/2" Hooping 10" C. to C.
2'6"
5'0"
Top Bar 4-0" lg
One Bar Equal to Area of the Two Bars called for
End Tiles filled with Concrete
Section A-B. (As Designed)
Third Floor Beam Details.
Typical for 2nd and 4th Floors.
Roof similar but lighter Construction
1st floor similar but heavier Construction
Section A-B. (As Erected)
Basement.
1st Floor
2nd Floor
3rd Floor
4th Floor
Typical Column Sections.
ENG. NEWS.
Note. This discrepancy between drawing and description is an original draming. - Ed Eng. News

FIG 2. DETAILS OF REINFORCED-CONCRETE MEMBERS OF THE HENKE BUILDING AS DESIGNED.

*Baird and Saurbrey, Architects and Engineers, Cleveland, O.

†Engineering News, Dec. 8, 1910, p. 637.

‡Engineering News, Jan. 26, 1910, pp. 106, 116.

only parts of the new work standing to the full height of the original work was the southeast corner where the stair and elevator walls braced the exterior walls and kept the concrete work away from them. The original building had been destroyed by fire and some of the old walls had been left standing and were incorporated in the new work; this was all standing after the collapse without as incorporated. Besides, small portions of the new work were standing one story high at the northeast corner, and four stories high at the southwest corner. It may therefore be concluded that the reinforced concrete failed first, causing the collapse of the comparatively green new brickwork, but leaving the old and well seasoned work standing.

Construction Conditions.

In order to gain, if possible, a further insight into the cause of the collapse, a careful examination was made of the debris, as well as of the testimony given before the Commission referred to above, and at the coroner's inquest, which gave the following results:

Lumps of clay, varying in size from a hen's egg down were found in quantities throughout the reinforced concrete. One piece of concrete, apparently from the roof, containing probably about ¼-cu. ft. of concrete, had at least four such lumps in its surfaces, all within a few inches of one another.

Sawdust was found in films in many column joints, and also mixed with the concrete; chips of wood were in evidence, and even a rind of pork (about the size of a hand) was found in one column. Honey-combed concrete was frequent.

The spacing of the U-bars in the girders, and of the hoops in the columns, was irregular in many cases; the irregularities were sufficient to defeat the purpose of these elements, as in one case the distance between hoops was 42 ins.

One vertical column bar was split longitudinally so as to divide the bar into two semicircular halves, the bar opening up along what appeared to be a rolling joint where the material had been poorly welded together. (Rerolled steel was used.)

Short pieces of electric conduit pipe were found embedded in the concrete of the girders—apparently waste ends carelessly disposed of.

The floor tiles were frequently partly filled with concrete, sometimes as much as ½-in. to 1 in. in each pocket, thus adding to the dead weight of the floors and robbing the ribs of the cement.

Generally speaking, the mortar did not adhere well to either tile or brick, although there were notable exceptions to this.

The boiler did not show evidence of explosion.

The column sleeves were in many cases too large, so that they did not do what they were intended for, viz., to bring the bar of the upper column to bear directly upon the bar of the column below, centering the rods on top of one another.

The ends of the bars were not squared so as to give a full and true bearing of rod against rod.

The sleeves did not appear to have been filled with mortar in all cases.

Retempered mortar had been used in the masonry; mortar left on the boards in the evening was collected in wheelbarrows on the following morning and mixed up with cement and water, the specifications calling for lime-cement mortar.

The masonry piers in the first story should have been laid in cement mortar, according to specifications, but lime-cement mortar appears to have been used instead.

The lime in the mortar was not well slacked; one foreman testified that "it might have been a little warm."

The face brick was specified to be bonded to the backing with a header and stretcher course every third course; as a matter of fact, the headers were used only in every sixth course below the second floor, and only in every fifteenth or sixteenth course above the second floor.

The use of hollow brick for headers was prohibited by the specifications, yet they were used in this manner in several places.

Large, full-size bonding stones were called for in the first story masonry piers of the front at top, bottom and middle; but only the top stone was as specified, 8-in. and 12-in. facing being used for the entire balance of the piers.

The mason work generally was not of the best; according to one (sworn) witness, face brick was run up on the outside, and hollow brick on the inside, and bats were then filled in between and given a dose of mortar. The construction of the northwest corner pier was peculiar; in the first story, about one-half of this pier was left standing after the fire, and the new work was simply built onto the old as a facing, without effective bonding. In the bottom course of this pier, a filling with loose shims of brick, without any sign of mortar, was found between this facing and the old work. In addition, this pier seems to have been only 21 ins. thick instead of 30 ins., as called for.

Materials.

The sand for the brick mortar was hauled from other excavations. The specifications called for washed sand, but it does not appear that any steps had been taken to wash the sand. Much of this sand was severely criticised by witnesses, and some six or seven loads were rejected at one time by the architect's superintendent. Nobody seemed to know what became of these loads, and

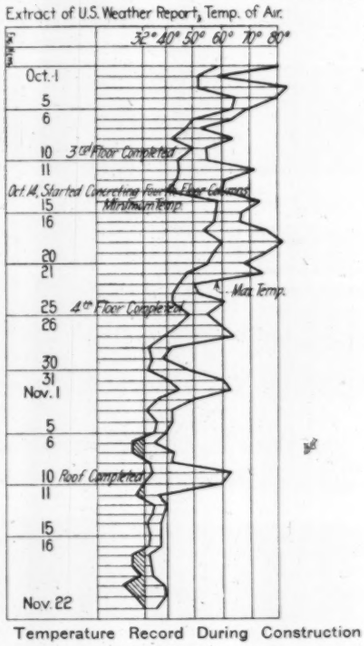

Fig. 3. Temperature Record During Construction of Building.

there was no evidence submitted to show that it was removed again.

The reinforced-concrete work called for washed sand; the sand used came out of the cellar of this building without being washed. It has been stated that the quality of this sand varied considerably; the sample obtained by the writer was analyzed and contained 12.2% of loam by volume, and it is claimed that some of the sand was inferior to this sample. A comparison test gave the following results:

1:3 MORTAR.

	7 Days old, lbs. per sq. in.	28 Days old, lbs. per sq. in.
Henke, original	309	433
Henke, washed	320	408
Standard Sand	240	383

(Report by Messrs. Crowell & Murray.)

The sample tested cannot be said to be poor sand by any means, although good concrete sand, in the writer's opinion, ought to run about 50 to 100% stronger than standard sand. The American Society for Testing Materials recommends a strength of 70% of that of standard briquettes as a minimum, but in this locality such sand would most certainly result in concrete of the poorest quality.

The concrete of the roof was very soft when examined; the concrete of the fourth floor less so. It seemed that the fourth floor was in a condition of slow hardening; the concrete had fractured along the surfaces of the stone aggregate rather than through the stones, as would be the case with good hard concrete, especially when the stone is of the softer varieties (Euclid Blue Stone, a soft stone, was used). The third floor, and those below, were all in the process of drying out, and the concrete did not seem to be especially poor. It is quite difficult to make any definite statements in this respect, because in falling the concrete had been shattered somewhat, and the adhesion of the several parts had suffered thereby. It has been stated that one of the first floor girders had bulged, due to weakness in the form work, and that the concrete was dressed down to the proper dimensions only with considerable trouble, so that the concrete seemed very hard and of good quality to those who saw the repair work going on in this place. On the other hand, nearly all the floor rods had pulled out of the standing columns, the only exceptions being in a few cases in the first floor, where the rods had snapped apart. The several floors had been completed about as follows, within one or two days:

First floor completed about Sept. 4, age at collapse, 79 days.
Second floor completed about Sept. 23, age at collapse, 60 days.
Third floor completed about Oct. 10, age at collapse, 43 days.
Fourth completed about Oct. 25, age at collapse, 28 days.
Roof completed about Nov. 10, age at collapse, 12 days.

The weather, with the exception of the last few days, had not been actually dangerous for concrete work, as will appear from the diagram (Fig. 3). The fourth floor, and especially the columns under same, had had at least two weeks of fairly favorable weather. The concreting of the fourth floor had been started on Oct. 14 and the columns were in all cases concreted before the floor. Considering the weather and the age of the various floors, it seemed to the writer that the concrete was setting slower than he would have expected of a 1:2:4 mixture as specified.

The stone used was the usual "Blue Stone" used for concrete work in this vicinity. It is a fairly soft, easily fractured stone, and much inferior to the granite or trap rock used in the East. It is found on a bed of shale, and care must be used in quarrying so as to avoid the layers of shale and rotten stone. The dust clings to the moist stone with great tenacity, and it is very difficult to get rid of all the dust, or to have the dust uniformly distributed throughout the mass. A screen test of 1-in. stone as it leaves the screens at the quarry, made by the writer in November, 1909, showed that about 25% of this material (by volume) passed the screen with four meshes to the lineal inch, but when the cars are shipped the dust goes to the bottom and the coarse stone to the top, so that it is difficult to keep a uniform mixture. It seems highly probable that the mixture used, while apparently a 1:2:4 mix, was really a 1:3:3 mix, at least at times, one part of the stone acting more like sand. Such a mixture would naturally be rather slow setting.

The cement was of five or six different brands, principally Newcastle cement, of which latter brand 990 bbls. had been used after a satisfactory test by competent parties. It has been stated that a total of 1,437½ bbls. of cement of all kinds were delivered, the balance apparently having been used without any test report. Some of this cement was natural cement, intended for filling in between the floor sleepers, but there is nothing to indicate that any of this cement found its way into the reinforced concrete. The total amount of cement required to finish the building to the state of completion attained on Nov. 22 has been estimated at 2,034 bbls. It seems that in addition to the 1,437½ bbls. mentioned as accounted for above, another portion, of perhaps 150 bbls. had been delivered, so that the probable shortage of cement is about 400 bbls., or 25%. This circumstance would also explain in part that the concrete was slow setting.

From the annual report of the City Water Department for 1909 (the 1910 report is not available) it was found that the city water varied in temperature from 60° F. on Oct. 1 to a mini-

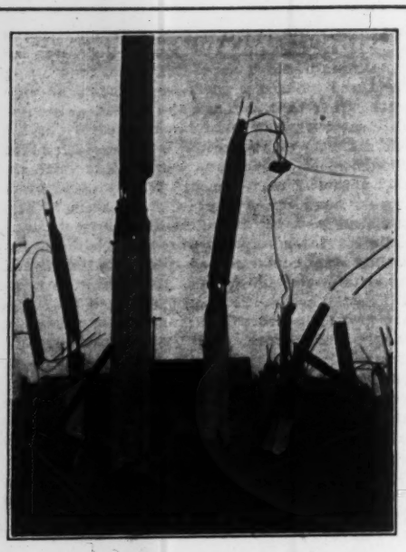

Fig. 4. View of Standing Columns After Collapse.

Girder rods of second floor pulled out, tearing concrete apart.
Standing at right background: One column two stories high. Rods of third story column attached but badly buckled; fourth story column suspended by one rod.
Standing at left background: One column two stories high, part of third story column attached, with projecting bars folded together as blades of a jack-knife.

mum of 42° on Dec. 1. The water for the concrete was used directly from the mains, but during cold weather the exhaust steam from the mixer engine was connected to the feed pipe, thus heating the water a trifle. It is not believed that the amount of oil thus introduced would have any effect upon the concrete.

Possible Causes.

If now a number of shores had been removed immediately before the collapse, it would have been sufficient to point to this circumstance in order to explain the wreck. But such was not the case; at least nothing of this kind has been proved. All the witnesses agreed that no shores had been removed for the last four days before the collapse, so that the slabs and beams had been in the same condition for days without showing any sign of distress. The additional load placed on the building during the last day or days is not wholly insignificant, but is confined to a strip along the south wall where the saddles for the roof had been concreted, and a small portion of the third floor, along the west wall, where ballast had been placed on the floor. It is not believed that these additional loads brought about the collapse.

It is now pretty well established that beams do not fail without warning except as a direct and immediate result of removal of forms or similar sudden demands upon their strength. A different condition may exist in the case of columns; these may possibly be in a state of approaching collapse without any apparent indications of trouble, and then suddenly fail from some insignificant vibration, caused by a passing street car or truck.

Five of the third story columns have been positively identified by the writer. Two of them are shown in Fig. 4; in both cases the third story column is hanging down from the standing second story column, suspended by the column rods. The one on the left of the view is evidently stripped of its concrete in its upper portion, while the lower portion of the concrete is fairly intact. The rods are bent over about midway, folded together as the blades of a jack-knife fold. The column at the right is entirely stripped of its concrete, and the rods are bent and twisted together, in such a manner as might have been the case if the concrete had been very soft, and the column had failed by compression.

Another column of the third story was found near the chimney. One end of the concrete was in fairly good condition, while the rods projected out from this portion without any concrete sticking to the rods at all. The projecting bars were bent into a very characteristic double S-curve.

At the northwest corner of the building the rods of two third-story columns were found, without any sign of the concrete. These rods were bent and twisted into similar double S-curves.

No other third story columns have been positively identified.

It seems that these five columns point to a column failure in the third story. The absence of all or part of the concrete would indicate that part of this concrete was much softer than that which has been found of the same story. A local failure of any one column or any one girder or slab-panel would hardly account for the final destruction of the entire building. It seems, therefore, that some disastrous mistake must have been made in the concreting of a number of the third story columns.

Two such incidents have come under the writer's observation at other times. In one case, several carloads of quick-setting cement were used; the concrete hardened in the wheelbarrows before it could be dumped, and it appears that the men mixed the concrete up with more water before depositing in the forms. The resulting concrete was extremely soft after setting for several days in hot summer weather, and it was

Fig. 5. Close View of Base of a Column.
(Column torn to pieces when floor girder rods pulled out; first floor level.)

all finally removed except one wall, which hardened after a very long interval. In another case, the columns of a large building appeared smooth and true outside, while as a matter of fact large cavities existed inside. This had been brought about by the arching in the forms of several batches of rather dry concrete, while the finer stuff had found its way down along the outside, the spades being used outside the steel only. When the weight on these columns increased due to the erection of an additional story the thin outer crust gave way, and the columns slowly telescoped. This trouble was discovered in time and no serious damage resulted.

It would be hasty to assert that either of these incidents were repeated here. Possibly the clay in the concrete, combined with the slow setting qualities of the concrete, would suffice to account for the collapse. But in view of the age of the concrete (more than four weeks) and the moderate load on the columns, this seems hardly probable. The columns are 14 x 14 ins. in section, and about 12 ft. high between floors. Each column had to support a load not exceeding 53,600 lbs. at the time of the collapse, while the shoring gave some assistance, if not much. Disregarding entirely the longitudinal rods, the stress on the concrete could not exceed 274 lbs. per sq. in., and it was probably somewhat less. The design of these columns is therefore of no significance whatever, even if a more efficient method of reinforcement would have been desirable.

According to the testimony, about three 4 x 4-in. shores should have been found in each in the third story at the time of the collapse excavations made have so far failed to d any shoring in the third story, but inasmu only small areas have been excavated it possible to make any positive statements present time.

It is not deemed expedient to enter into cussion of the direct responsibility for catastrophe; these matters will soon be i hands of the courts. It may be said, how that some such thing was bound to happen s or later in Cleveland, as a result of the ind ence of those who should be most intere viz., the architects. It has been custom a many architects to leave everything to the tractor, from the making of the plans to removal of the shores, with the result that contractors have developed quite peculiar m ods of doing their work. For this reason, haps, an ordinance was passed a couple of y ago compelling the owner of a reinforced-crete building to keep a competent inspector the work at all times when steel was pl and concrete poured, said inspector to be proved by the Department of Buildings, an make daily reports to the Inspector of Build Needless to say this ordinance has never b enforced; and indeed, it is sometimes almost possible to have temporary inspectors of this kind handy at a moment's notice, and especially on small work.

The Henke disaster does not add much to the knowledge of the profession. The design was not inferior to those in common use on buildings which seem to stand in good shape, and the mistakes made in the erection of the building are always likely to be repeated where contractors rely upon indifferent supervision. A great deal of agitation has been stirred up as a result of the collapse, with a view to licensing engineers, architects and contractors, but it may be argued that the parties connected with this particular building would have been among the first to obtain such licenses. If, however, a much-needed revision of the local building regulations should result, the community at large would certainly be the gainer, as the present code is a bewildering mass of exceptions to rules, conflicting regulations, amendments, etc. The force employed by the Department of Buildings is wholly inadequate for the work imposed upon it, but the recent introduction of the "fee system" in granting permits promises some betterment in this respect.

Fig. 6. Looking South Along the West Wall, Henke Building Failure.

(Showing northwest corner pier as it stood after collapse. Second story column of rear, one end resting on west wall; other end (not shown) resting on first story column. This wall was old, and was reinforced with concrete pilasters when the new work was erected.)

Concrete Tables and Tanks for a Laboratory.*

By W. K. HATT,† M. Am. Soc. C. E.

The [illegible] cement laboratory of Purdue University is what [illegible] formerly the foundry. It includes a lecture room, 27 × 37 ft., cement testing laboratory, 39 × 42 ft., and concrete laboratory, 27 × 39 ft.

FIG. 1. CONCRETE MIXING TABLES IN THE CEMENT LABORATORY AT PURDUE UNIVERSITY.

For the cement laboratory, special concrete tables, shelves and mixing tanks were designed by Prof. H. H. Scofield. Their advantages are the lower cost and greater durability over other forms of tables, and (more important) the more sightly and appropriate appearance. The objections urged in advance were that, in addition to the increased cost, the cement tops would absorb water from the cement mixtures (or add water to them), and would wear under the action of the trowels. The tops were waterproofed. Before beginning tests, the tops are moistened, and it is thought that there will be no disturbance of the work on account of the moisture conditions of the tables.

The tables are shown in Figs. 1 and 2. The formwork in the compartments was left in place and serves as shelving. The doors (not shown in Fig. 1) are attached to this formwork. The debris from the work is scraped to the two openings, beneath which is a galvanized receptacle. The reinforcement has prevented all but a few minor cracks, and the construction is considered satisfactory in use and a source of pleasure to the eye.

The contract price of construction of this work is as follows:

9 mixing tables, at $25	$225
83 ft. wall benches, at $2 per ft.	166
20 ft. table, at $2.50	50
1 double-back hardening tank	60
72 locker doors, with locks	72
Labor, carpenter hanging doors	13
Total	$606

*Abstract of a paper presented at the annual meeting of the Indiana Engineering Society, at Indianapolis, Jan. 12.

†Professor of Civil Engineering, Purdue University, Lafayette, Ind.

The concrete for the body of the tables is proportioned as 1 part cement to 3 parts mixed sand and gravel, the latter being smaller than a ½-in. screen. The tops and the edges of the tops were faced with a 2:3 mortar (sand smaller than a No. 8 sieve), and given a troweled finish.

The forms for the ends and sides of benches and tables were made of dressed lumber, coated with shellac. The surface of the finished concrete was given two or three brush coats of neat cement slush or grout.

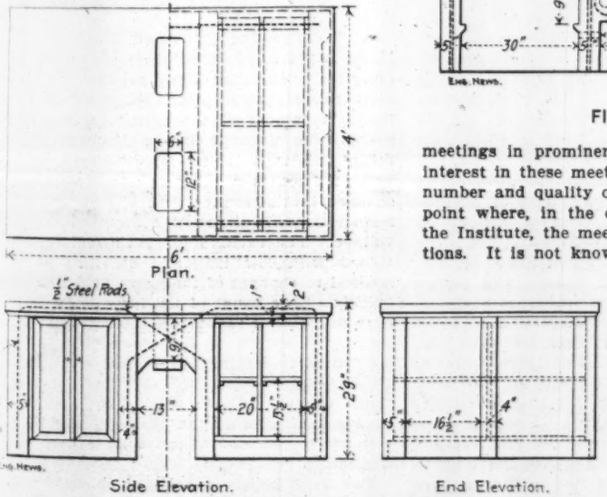

FIG. 2. CONCRETE MIXING TABLE.

Mid-Year Convention of the American Institute of Electrical Engineers.

The first mid-year convention of the American Institute of Electrical Engineers was held in Schenectady, N. Y., and Pittsfield, Mass., on Feb. 14, 15, 16. This mid-year convention was the outgrowth of a plan of holding enlarged section meetings in prominent industrial districts. The interest in these meetings has increased, and the number and quality of the papers has risen to a point where, in the estimation of the Directors of the Institute, the meetings should be true conventions. It is not known just what form this development will take in the future, but certainly the Pittsfield - Schenectady meeting proved as successful from every point of view as any convention or other meeting of the Institute yet held. The first and third days' sessions were held in Schenectady, and for the second day the convention was transferred to Pittsfield. Much was done by the members of the Institute sections in these two places to please the visiting members. The General Electric Co., whose large works in these two places proved of great interest, contributed no little to the success of the convention by throwing open their works for inspection and by giving informal luncheons. The officers of the company followed a broad policy in respect to the papers presented. Many of these papers were by engineers of the company, and much of the interesting discussion was given by other engineers closely connected with the work discussed in the papers. The company's practice and experience was thus made public without restrictions which might have been expected.

The Schenectady meetings were held in the house of the Mohawk Golf Club, about two miles out of the city. In the evening of these two days there was a demonstration of a 200,000-volt transmission line, erected by the General Electric Co., to show the effects of corona, or visible conduction from wire to wire. This line was worked under good weather conditions, so that the wires could be traced as faint lines of light. It was said that the loss by corona over this half mile of line amounted to 10 KW.

When the convention moved from Schenectady to Pittsfield a special train was secured for the transportation of the members. Arriving at Pittsfield, the train was switched into the yards of the General Electric Co., where lunch was served before a tour of the works. An interesting feature of this luncheon was the opportunity given to the members to use electric cooking apparatus which was distributed about the hall. The principal apparatus made in the Pittsfield works is transformers, and among the interesting sights were a partially and a wholly completed 750,000-volt transformer for insulation testing. Use of the finished one was demonstrated. An interesting variety of small motors was also shown during the inspection. At the close of the one technical session held in Pittsfield a moving-picture show was thrown open to the members as relaxation after the technical discussions. In the early evening a complimentary dinner was given to the visiting members at the Hotel Wendell. Such an elaborate menu was prepared that there was barely time to receive the felicitations of the Mayor and the members of the Board of Trade, who evidently had done much to insure the success of the day in Pittsfield.

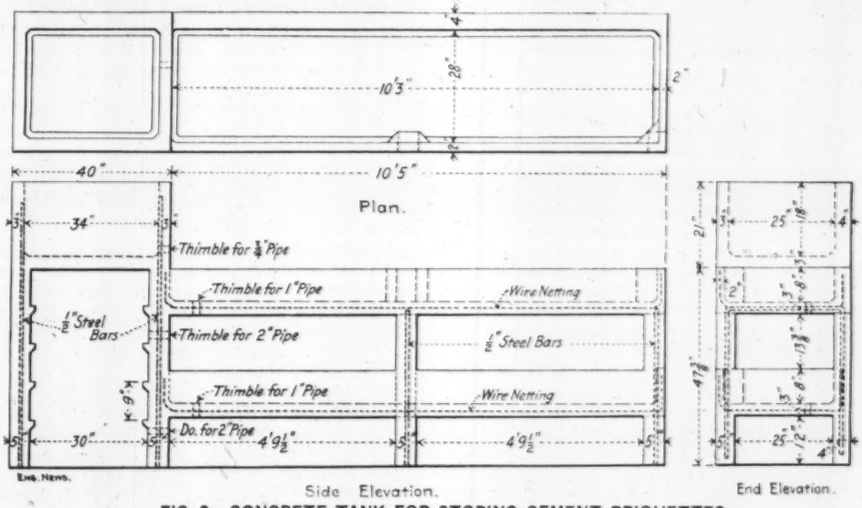

FIG. 3. CONCRETE TANK FOR STORING CEMENT BRIQUETTES.

Before the end of the convention, it was reported that the regular summer convention would be held in the third or last week in June and in the vicinity of Chicago. It was also announced that a constitutional amendment would soon be presented providing for an Honorary and an Executive Secretary, both at salary. This is being urged so that Mr. Ralph W. Pope, who soon completes his twenty-fifth year, may retire from active duty.

The registration during the convention was about 320, of which about a third were visitors.

Papers and Discussions.

INSULATION TESTING.—The first paper of the convention, "High Tension Testing of Insulation Materials," by Mr. A. B. Hendricks, Jr., of Pittsfield, was a description of tests on insulating materials for commercial electric apparatus to determine (1) breakdown voltage, (2) energy loss under alternating electric stress, (3) capacity. The apparatus described included (1) generators, (2) high-tension transformers, (3) controlling apparatus, (4) measuring instruments. Mr. A. H. Pikler, of Ampere, N. J., in discussion, commented on the departure from old methods of insulating by thick wrappings of fibrous material to the use of oils, varnishes, high-strength insulators and careful mechanical arrangement.

TRANSFORMERS.—Two papers at the first session discussed features of transformer design. In "Hysteresis and Eddy-Current Exponents for Silicon Steel," Mr. W. J. Woolridge, of Pittsfield, showed the results of tests on new alloy steels found useful for transformer cores. In "Commercial Problems of Transformer Design," Mr. H. R. Wilson, of Pittsfield, outlined the contrasted engineering and commercial conditions, such as efficiency and first cost, individual design and standardized materials, floor space and height, fine finish and high cost, close regulation and ability to withstand short circuits, etc., which had to be considered.

The technical session in Pittsfield was devoted to what might be called mechanical-engineering of transformer design. With increase in size of generating and transmission systems, trouble has been found with distortion and disruption of electric windings and with the dissipation of heat, and these problems were discussed.

The first paper, "Mechanical Forces in Magnetic Fields," was by Dr. C. P. Steinmetz. Methods of computing the forces imposed by heavy currents, were arranged in convenient form for the use of electrical engineers. The relations between the different forms of energy involved were not considered and the law of the conservation of energy was used to bridge over the transitions. Thus, when mechanical motion is produced by the action of a magnetic field on a conductor, energy is consumed by inducing a voltage; at the same time the stored magnetic energy of the apparatus under consideration might change, but the electric energy consumed by the induced voltage is equal to the mechanical energy produced, plus the increase of the stored magnetic energy. This, in brief, was the general method of analysis. The consumed electric energy and the stored magnetic energy are easily calculated, as they involve one form of energy only. For cases where mechanical work is not done but mechanical forces exist when the parts of the apparatus are supported against motion, the same method of computation was proposed by assuming a differential distance of motion and equating the force equal to differential work divided by differential distance.

The second paper was "Problems in the Operation of Transformers," by Mr. F. C. Green, of Pittsfield. Here the troubles frequently found with installed transformers were reviewed, with recommendations for preventing or remedying the troubles. Among the points taken up were the effects of moisture in the winding, the puncture between windings and between winding of the core, improper care of the cooling facilities, test connections, etc.

The third paper of the session was "The Regulation of Distributing Transformers," by Mr. C. E. Allen, of Pittsburg, contained a compilation of formulas for computing the drop in voltage from no-load to full-load current. A few words were added on mechanical arrangements of parts affecting this regulation.

In the fourth paper, "Temperature Gradient in Oil-Immersed Transformers," Mr. James M. Weed, of Pittsfield, discussed the application of the laws of heat transmission, radiation and convection to the design of transformers, so that maximum temperatures at windings might be known as well as averages in iron and oil. The paper was the outline of a proposed plan for investigations.

There was a fifth paper, "Dissipation of Heat from Self-Cooled Oil-Filled Transformer Tanks," by Messrs. J. J. Frank and H. O. Stephens, of Pittsfield. Here were described the common methods of increasing convection from transformer cases—by corrugations, ribs, pipes, barriers, etc. Test data were given showing common relations between temperature and dissipation per unit area.

HIGH-TENSION TRANSMISSION.—The second session on the evening of the first day was given over to topics relating to power transmission. The first paper, "Design, Construction and Tests of an Artificial Transmission Line," by Mr. J. H. Cunningham, of Union College, described the construction of laboratory equipment with which the characteristics of the high-voltage, long-distance transmission line could be secured with a conductor located entirely in the laboratory. This was desired in order to study certain transient phenomena following switching, sudden load changes, etc., and as actual lines are not readily available for such studies. The two most prominent characteristics of such transmission lines are, of course, distributed capacity and self induction. These qualities were secured in the artificial line by winding the wire in coils on large glass tubes, and by lining the inside of the tubes with tinfoil.

The second paper, "Protection of Electrical Transmission Lines," by Prof. E. E. F. Creighton, of Schenectady, was largely a discussion of preventing destructive arcs to earth from transmission lines started by flash-overs around an insulator. An apparatus was described which had been developed to remove these arcing grounds as soon as formed and without shutting off power from the line or from interfering with the normal service. This "arcing-ground suppressor" may be briefly described as an oil switch which connects the particular wire in trouble with the earth, so that the arc goes out, being short circuited. This oil switch is operated by a selective relay influenced by the unbalance of normal conditions caused by the ground. After the arc has been removed, the switch opens the connection of the wire to ground. The second part of the paper contained a more general discussion of protection of transmission lines from high voltages, whether imposed from external sources, like the atmosphere, or arising from internal disturbances.

The third paper, "Tests of Grounded Phase Protector on the 44,000-Volt System of the Southern Power Company," by Mr. C. I. Burkholder, of Charlotte, N. C., and Mr. R. H. Marvin, of Schenectady, described some tests of the apparatus designed by Prof. Creighton and described in his paper. This apparatus was installed on the lines of the Southern Power Co., near Catawba, N. C. It was found that the arc was extinguished in less than ½-sec. from the time of starting. This time was so short that there was no disturbance on the lines or interruption of service, because of the arc or of the operation of the grounding switch. The insulator was usually uninjured in this short time.

The last paper of this session was "Tests of Losses on High Tension Lines," by Mr. G. Faccioli, of Pittsfield. This was a compilation of the data secured by the author from the study of distrubing phenomena on the transmission line of the Central Colorado Power Co. At the same time it was possible to carry on some tests on line losses. As a result of the latter test, the author believed that the danger of corona losses assuming prohibitive values would be greatly increased if higher operating voltages were to be attempted under present conditions. The lines under test were operated at about 85,000 volts.

GENERAL.—For the last session five papers were scheduled, but on account of pressure of time two were dropped, and discussion on some of the others were extremely curtailed. The first of these papers was "Oil-Break Circuit Breakers," by E. B. Merriam. This was an outline of the development of apparatus for opening a high-tension electric circuit in which current is flowing. The author seemed to believe that the apparatus should not be designed or required to open the circuit immediately when abnormal current began to rush, as a result of a sh[ort] cuit, for instance, and not until the nat[ural] actions in the generator had reduced the from 35 or 40 times normal to 10 or 15. troducing such a time lag in the opera[tion] these circuit breakers, the author show[ed] the breakers would absorb corresponding energy from the arc which must necessar[ily] low opening the circuit. This he believed more economical design than for opening maximum value of current rush.

This view of circuit breaker design fo[r high] tension lines was not shared by all who dis[cussed] the paper, some maintaining that such pro[tective] apparatus should be designed to work bef[ore] trouble was all over, and should be desig[ned] to protect the line rather than to protect itse[lf]. It was contended that proper apparatus co[uld] be designed if the contact points were made r[apid]ly enough moving and disposed in multiple [arcs]. To this contention reply was made th[at] not merely the protection of apparatus was to b[e con]sidered, but that the continuity of service must be insured so far as possible. To that end [delay] of the main circuit breakers' action allowed the breakers in the different feeders to open, i[sol]izing the trouble and shutting off current only from the lines on which actual trouble exist[ed].

In "Proposed Applications of Electric Ship Propulsion," Mr. W. L. R. Emmet, of Schenectady, gave a brief review of the general advantages of proposed electric ship propulsion and showed specific comparison between straight turbine equipment and turbine-generator-motor drives designed for a battleship and a naval collier. In the former there would be two generating units and four motors, two on a shaft, for economical running at two different speeds. In the collier there would be one generating unit and two motors for cheaper construction, permitting only one truly economical cruising speed. In the first case, half the equipment is used for low speeds and in the second all apparatus is used for all speeds. In both cases, induction motors were proposed and economical speeds, in the case of the battleship were obtained by changing the number of poles of one pair of motors. For short periods, however, wide ranges could be obtained by varying the steam pressure. Good reversing torque is secured by having one pair of induction motors with coil wound rotors and slip rings so that heavy resistance could be connected into the secondary circuit.

In the discussion of Mr. Emmet's paper Dr. C. P. Steinmetz, of Schenectady, dwelled upon the increased space and weight economy and greater cruising radius given a battleship by the system outlined. These benefits he claimed were of great value at all times, but of prime value in case of war was the increased reliability, quickness and power for reversal in action. Mr. W. B. Potter, of Schenectady, called attention to the success which had been obtained with gas-engine motor cars where generators and motors had been interposed between the wheels and the engine. (Several such cars were shown, in various stages of construction, in the shops of the General Electric Co.)

In "Voltage Regulation of Generators," Mr. H. A. Laycock, of Schenectady, described recent types of the so-called Tirrill regulators for maintaining constant generator voltage. These change the field current of the exciter, which in turn changes the magnetic flux in the main generator fields, and with it the main voltage. Fall of voltage operates a relay to short circuit a resistance in the exciter field circuit and rise of main voltage, in the reverse way, reduces exciter voltage. The exciters for such service are designed with low magnetic densities so as to respond to changes of their own field circuit very quickly. On account of the large changes in exciter field-circuit resistance, the regulator is continually operating up and down, but the floating contact system is so sensitive and the changes are so rapid that the range of the continual changes is very small. By thus keeping the mechanism in motion, the correction of large voltage changes due to speed or load changes is immediate.

Two brief papers presenting opposite sides o[f]

a controversy in mathematical conventions of alternating currents were presented, in title, for Professor S. Franklin, of Lehigh University, and Professor J. J. Berg, of the University of Illinois. Much confusion has arisen of late from the use of both polar and rectangular coordinates for showing vector quantities, and the trouble has been found worthy of the attention of the International Electrochemical Commission. Prof. Franklin argued for the use of rectangular and Professor Berg for the polar diagrams.

Notes from Engineering Schools.

NEW YORK UNIVERSITY.—The engineering alumni association held its third annual reunion at the Hotel Brevoort, New York City, Feb. 11. Officers for the coming year were elected as follows: President, C. W. Staniford ('81); Vice-President, Wm. W. Brush ('93); Secretary, Walter S. L. Cleverdon ('00); Treasurer, C. Raymond Hulsart ('05); Directors, J. G. Van Horne ('72), E. J. L. Raldiris ('03), and R. H. Wellwood ('12).

COLUMBIA UNIVERSITY.—The Trustees of the University have announced an exhibition of illustrated books and prints showing the development of construction and transportation from the fifteenth to the eighteenth century. These have been loaned by Mr. William Barclay Parsons and may be seen in the University Library, each week-day afternoon from 2 to 5 o'clock, Feb. 1 to 25.

A DREDGE FOUNDERED in the Gulf of Mexico, Feb. 8, while bound from Galveston, Texas, to New York City. All but one of the crew of 28 men were drowned.

A COAL MINE EXPLOSION, Feb. 9, wrecked the Cokedale mine of the Carbon Coal & Coke Co. near Trinidad, Colo. Seventeen men were killed. Reports state that the explosion was that of a car of blasting powder in charge of the shot firers.

A POWDER MILL EXPLOSION at Pompton, N. J., Feb. 13, killed two men employed by the E. I. du Pont de Nemours Powder Co. The explosion occurred in the mixing house, which was entirely demolished. The two men killed were the only ones in the building.

A powder mill explosion Feb. 18 at Oliphant, near Uniontown, Pa., killed two men employed by the Du Pont powder company. The corning mill building and machinery were demolished.

CHICAGO RAILWAY TERMINALS are to be investigated by a special commission which will be appointed by the Mayor. The commission will be composed of eight members of the City Council and seven railway men and real estate dealers, with the Mayor as chairman. The purpose is to try to devise some systematic arrangement and interconnection of the numerous passenger and freight stations; also to so locate the former as to make them more accessible and improve the congestion of street traffic.

A PREMATURE BLAST at Kitselas, B. C., Feb. 12, in a small tunnel of the Grand Trunk Pacific Ry., killed five workmen.

ELEVATED-RAILWAY TRAFFIC in New York City during 1910 has recently been reported by the Public Service Commission for the First District of New York. The total number of tickets sold was 299,415,319, made up as follows from the four lines: Second Ave., 43,908,597; Third Ave., 137,452,445; Sixth Ave., 86,619,222; Ninth Ave., 31,435,055. The total is an increase of 4.54% over 1909. This is also 10.8% greater than the subway traffic for 1910, the mileage of the whole elevated system being larger than the single divided subway line. (See Engineering News, Feb. 9, p. 180.) The increases over 1909 on the several elevated lines noted were 3%, 0.74%, 2.52% and 3.03%, respectively. The combined surface and elevated traffic for 1910 amounted to 569,736,809 passengers.

BOILER, ELEVATOR AND FLYWHEEL ACCIDENTS in the United States and Canada during the month of November, 1910, are listed in bulletins issued by the Fidelity and Casualty Co. of New York. Boiler accidents during the month numbered 40, in which 23 persons were killed.

The 91 elevator accidents during the month killed 24 persons. It is notable that only three of these fatalities were caused by the falling of elevators. More than 50% of the victims (13) were caught and crushed between elevator and wall or floor, and 33⅓% were killed by falling down elevator shafts.

Five flywheel explosions were reported for the month (including one emery-wheel explosion). Two persons were injured and in two cases there was heavy property damage, but no fatalities were reported.

THE TIME ALLOWANCE FOR CHANGING from electric to steam locomotives and vice versa, at the Manhattan Transfer Station of the Pennsylvania R. R. near Harrison, N. J., is four minutes. Owing to the difficulty of detaching the steam hose from the engine during cold weather, it has not been thought advisable to make a shorter time allowance during the winter months, but with the warm weather it may be cut down. From 106 to 109 trains pass through the transfer yard on week days, and 98% make the shift of locomotives within the time allowed. The lowest time record for making the change is 1 min. 30 sec.

THE ROOSEVELT DAM, Salt River Irrigation Project, Arizona, will be formally opened on March 18 with ex-President Theodore Roosevelt as the guest of honor. The last stone in the parapet walls and the dam was laid at noon, Feb. 5. The dam has a total height of 284 ft. from foundation to parapet and a top length of 1,080 ft. A 20-ft. roadway extends across the top of the dam. The reservoir formed by the dam has a length of 25 miles, a maximum depth of over 200 ft. and an approximate capacity of 56,628,000,000 cu. ft. (enough to flood the State of Delaware to a depth of 1 ft.). The water stored by the dam will be used in irrigating some 200,000 acres of land near Phoenix. In addition, hydro-electric power will be developed at the dam site, and used for pumping underground water to irrigate some 60,000 acres of land located about 100 miles down the valley. Articles on the Roosevelt Dam have appeared in Engineering News of Jan. 12, 1905; May 30, 1907, and Sept. 10, 1908.

A BILL TO LICENSE ENGINEERS has been introduced in the Ohio Senate by Mr. J. I. Hudson, of Portsmouth, Ohio. The bill was referred to the Senate Committee on Roads and Highways, which has made a favorable report upon it. This bill creates a State Board of Registration and Examination for Civil Engineers, Mining Engineers and Surveyors. In order to be registered as a surveyor, an applicant must be examined in mensuration, solutions of triangles, practical problems in surveying and leveling and the care of surveying instruments. The bill gives a line of subjects in which applicants for licenses in civil engineering must be examined, and also a list in which applicants for licenses as mining engineers must be examined. After the act has been in force a year, no document or drawing for which the services of a civil or mining engineer are required can be filed for public record unless it has been approved by a registered civil or mining engineer. The fees are fixed at $15 for surveyors and $25 for civil or mining engineers. There is no penalty imposed in the act for practising civil or mining engineering or surveying without a license. A fine of from $50 to $200 is provided, however, for the use of the term "registered civil or mining engineer" after his name by an unlicensed engineer.

THE LAKES-TO-THE-MISSISSIPPI DEEP WATERway project is not looked upon with favor by the special board of engineers created in June last to consider and report upon a waterway across the State of Illinois from the end of the Illinois Drainage Canal to the mouth of the Illinois River. The board of engineers was composed of Gen. W. H. Bixby, Chief of Engineers; Col. C. McD. Townsend, Major C. Keller, Major J. B. Cavanaugh and John Bogart, M. Am. Soc. C. E. The board advises that a depth of 8 to 9 ft. is sufficient for the proposed waterway, and that the 14-ft. depth so strenuously insisted upon by certain advocates of the waterway is greater than necessary for river navigation and entirely insufficient for either lake or ocean vessels. The board estimates that about $4,000,000 would be sufficient for the construction of a 9-ft. waterway from Utica, Ill., to the mouth of the Illinois River. It considers that a bottom width of 160 ft. in canal and 200 ft. in open river would be sufficient for a channel of the depth proposed. Such a channel would permit barges carrying 3,000 tons of freight to be used, and such a waterway would have a traffic capacity exceeding 100 million tons per annum. The board shows that on such a waterway, freight could be carried more cheaply than it could be in larger vessels on waterways of greater depth.

THE MORRIS CANAL IN NEW JERSEY, owned by the Lehigh Valley R. R. Co., is to be abandoned if the company can secure the consent of the state. The canal was built in the years from 1828 to 1836, and cost originally over $5,000,000. It was designed by its engineers to have a carrying capacity of 1,000,000 tons per annum, each way. In its year of heaviest traffic, 1866, it carried 890,000 tons, and had gross earnings of $616,000. Its tonnage and earnings rapidly fell off after this, and after 1876 its earnings were never equal to its operating expenses. For many years past the traffic on the canal has been trifling, and the gross losses in its operation during the last twenty years have been nearly $5,000,000.

The largest boat on the canal carries only 70 tons of freight, and requires five days to make the trip across New Jersey from the Delaware River at Phillipsburg to the Hudson at Jersey City—a distance of 102 miles. In order to make the trip, the boat, which is built in two sections, has to be separated and hauled from one level to the other at 22 different incline planes and has to pass through more than 30 locks. In comparison with this, a single locomotive on the Delaware, Lackawanna & Western R. R. or the Central Railroad of New Jersey, which parallel the canal, will haul 2,000 tons of coal between the same terminal points in five hours.

The railroad company asks nothing from the State of New Jersey but the privilege of abandoning the canal. In this abandonment the water rights in connection with the canal owned by the company will all vanish. Of the 106 miles of right-of-way of the canal, four-fifths will revert to the former owners. The canal company will have left from its original investment of more than $5,000,000, a canal-boat basin at Jersey City, certain disjointed parts of the right-of-way, and some dams and lands at lakes which have been used in connection with the water-supply of the canal. With these assets, it must pay off a bonded debt of $500,000, satisfy stockholders holding $2,250,000 of stock and also claims of the state for taxes uppaid.

THE INCREASE IN THE NUMBER OF OFFICERS of the Corps of Engineers, U. S. A., provided for in House Bill 7117, has been provided for in another way, by the addition of an amendment to the River and Harbor appropriation bill. When the former bill was brought up in the Senate at the present session of Congress some opposition was expressed and Senator Bailey threatened to talk the bill to death if its passage was pressed. Its main features, therefore, have been added as Senate amendments to the River and Harbor appropriation bill, which bill is now in conference. We print portions of the amendment of most interest to our readers as follows:

That whenever it shall be necessary in order to properly prosecute works of river and harbor improvement the Chief of Engineers is authorized to detail for duty in charge of river and harbor districts or as members of boards of engineers any assistant engineers in the employ of the Engineer Bureau of the War Department.

Vacancies in the grade of second lieutenant in the Corps of Engineers shall hereafter be filled, as far as may be consistent with the interests of the military service, by promotions from the Corps of Cadets at the United States Military Academy.

Provided, That vacancies remaining in any fiscal year after the assignment of cadets of the class graduating in that fiscal year may be filled from civil life as hereinafter provided. And provided, further, That the proportion of any graduating class assigned to the Corps of Engineers shall not be less than the proportion which the total number of officers authorized at date of graduation for that corps bears to the total number of officers authorized at same date for all branches of the Army to which cadets are eligible for promotion upon graduation except when such a proportionate number is more than the number of vacancies existing at date of graduation plus the number of retirements due to occur in the Corps of Engineers prior to the first day of the following January.

To become eligible for examination and appointment, a civilian candidate for the appointment as second lieutenant must be an unmarried citizen of the United States between the ages of 21 and 29, who holds a diploma showing graduation in an engineering course from an approved technical school and is eligible for appointment as a junior engineer under the Engineer Bureau of the War Department.

THE NATIONAL WATERWAYS COMMISSION, whose term of office expires on March 4, 1911, is to have two years longer service, according to a Senate amendment to the River and Harbor bill. The Commission is required to further investigate:

the advisability and feasibility of proposed artificial waterways and proposed plans for the impounding of flood waters in rivers by reservoirs or otherwise, including the following: First, the construction by the United States of the proposed canal from the Ohio River, at a point near Pittsburg, to Lake Erie, the expense thereof being borne by local interests affected; second, the proposed canal from Lake Erie, by way of the Maumee River and Fort Wayne, or other direct and feasible route, to the southerly end of Lake Michigan; third, the proposed canal to connect the Anacostia River at some point near the District of Columbia boundary line with Chesapeake Bay, or some tributary thereof; also upon the practicability and desirability of constructing reservoirs and other hydraulic works necessary for the storage and utilization of water, to prevent floods and overflows, erosion of river banks and breaks in levees, and to regulate the flow of streams and reinforce such flow during drought and low-water seasons in the drainage basin of the Ohio River and its tributaries.

Personals.

Mr. T. A. Shea, formerly Train Master of the Missouri Pacific Ry., at Little Rock, Ark., has been appointed Superintendent of the White River Division, with headquarters, at Aurora, Mo., succeeding Mr. J. W. Daniels resigned.

Mr. Myron H. Lewis and Mr. J. E. McCoy have formed a partnership for the practice of a general consulting engineering business, specializing in problems relating to waterproofing, dampproofing and the preservation of structural material, with offices at 30 West 33d St., New York City.

Mr. Edwin Styring, formerly Resident Engineer on the New York State Barge Canal at Rome, N. Y., has been appointed by State Engineer John A. Bensel, Division Engineer of the Middle Division, with headquarters at Syracuse, N. Y., succeeding Mr. Guy Moulton, M. Am. Soc. C. E.

Mr. James L. Tighe, M. Am. Soc. C. E., who has served the city of Holyoke, Mass, for the past 19 years as Engineer of the city water-works, and as City Engineer, has opened an office in the Caledonian Bldg., Holyoke, for practice as a consulting engineer, giving special attention to hydraulic and municipal engineering.

Mr. G. R. G. Conway, M. Am. Soc. C. E., until recently Chief Engineer of the Monterrey Railway, Light & Power Co., and the Monterrey Waterworks & Sewer Co., of Monterrey, Mex., has been appointed Chief Engineer of the British Columbia Electric Ry. Co., and subsidiary companies, with headquarters at Vancouver, B. C.

Mr. Frank Koester, Assoc. Am. Inst. E. E., formerly with the Interborough Rapid Transit Construction Co. and the American Smelting & Refining Co., of New York City, has opened an office at 115 Broadway, New York City, as a consulting engineer.

Mr. F. O. Walsh, formerly Master Mechanic of the Atlanta & West Point R. R. and the Western Ry. of Alabama, sailed from New York on Feb. 18 for Brazil, where he is to accept a similar position with the Central R. R. of Brazil. Mr. Walsh entered the railway service in 1887 as machinist apprentice with the Louisville & Nashville R. R. His headquarters in Brazil will be at Sao Paulo.

The Chicago Great Western R. R. announces the following appointments: Mr. C. E. Carson is appointed Superintendent of the Western Division, with headquarters at Clarion, Iowa, succeeding Mr. M. Dailey, resigned; Mr. W. B. Causey is appointed Superintendent of the Southern Division, with headquarters at Des Moines, Iowa, succeeding Mr. J. A. Gordon, who has been transferred to the Eastern Division, with headquarters at Chicago, Ill. succeeding Mr. Causey.

Prof. J. C. Branner, M. Am. Inst. M. E., of the Department of Geology of Stanford University, California, will start on April 15 on an exploring trip of a portion of the coast of Brazil. Prof. Branner has previously been engaged in scientific work in Brazil as Special Agent for the U. S. Department of Agriculture for Investigating Cotton and the Insects Affecting It in Brazil, and as Special Assistant of the Geological Survey of Brazil. The Brazilian government will aid in the present expedition.

Obituary.

John E. Payne, President of the Erie & Western Transportation Co., a subsidiary company of the Pennsylvania R. R., died at his home in Toledo, Ohio, on Feb. 13, at the age of 68 years.

John Franklin Hinckley, M. Am. Soc. C. E., a consulting engineer of St. Louis, Mo., died on Feb. 20, aged 62 years. For a number of years he was connected with the engineering department of the Frisco Lines.

Hiram Taylor, a former railroad contractor, died at his home in Springfield, Mass., on Feb. 15. For a number of years he was engaged in contract work on the construction of the New York Central and the Massachusetts Central (now part of the Boston & Maine) R. R. lines in New York and New England. He was 77 years old and a veteran of the Civil War.

Edward J. Robinson, President of Waterworks Construction Co. of Cleveland, Ohio, died at his home in East Cleveland on Feb. 18. He was born in London, England, in 1864, and came to this country and settled in Cleveland when a young man. He organized the Waterworks Construction Co about seven years ago. He leaves a widow and one daughter.

Peter Leary, Jr., Brigadier-General, U. S. A., retired, Chairman of the Baltimore Sewerage Commission, died at his home in Baltimore, Md., on Feb. 13. He was born in Baltimore on Sept. 15, 1840. He served throughout the Civil War in a Maryland battery of artillery and was honorably mustered out in April, 1865, as a first lieutenant. He was later commissioned in the regular army and served in the West for a number of years against the Indians. He served in the Spanish-American War as a captain. He was retired in 1904 with the rank of Brigadier-General.

Ernest Benson Prior, Road Master of the surface lines of the Brooklyn Rapid Transit Co., died on Jan. 29, at St. Mary's Hospital, Brooklyn, N. Y., from appendicitis. Mr. Prior was born at Hillsdale, N. Y., in 1864. Before coming to the Brooklyn Rapid Transit Co. he had spent 14 years as Conductor, Traveling Foreman and Road Master on the New York Central & Hudson River R. R. In 1896 he became Road Master of the Brooklyn City R. R. Co.'s lines, and with the exception of a few months, during which he returned to the New York Central R. R., his service with this company and its successor, the Brooklyn Rapid Transit Co., was continuous. In 1905 he was appointed Road Master of all the surface lines of the company and during the past two years had also had charge of the building department. He was a member of the Brooklyn Engineers' Club and of the Masonic Fraternity.

William Ashbridge Baldwin, formerly President of the Cleveland & Marietta Ry., died at his home in Sewickley, near Pittsburg, Pa., on Feb. 17. He was born in Philadelphia, Pa., on June 28, 1835. He entered the railway service in November, 1851, as a chainman with the engineering corps of the Coal Run R. R. in Schuylkill County, Pennsylvania. From 1852 to 1854 he was Assistant Engineer for the same road. From 1854 to 1857 he was a leveler and topographer for the Lackawanna & Bloomsburg R. R. He left this position to become Assistant Engineer of the Honduras Inter-Oceanic R. R. in Central America, but returned to the States in December, 1859, as clerk to the Superintendent of the Western Division of the Pennsylvania R. R. He soon became an assistant engineer for the same road and in 1862, Superintendent of the Western Division of the Philadelphia & Erie R. R. From this position he rose successively to the position of Assistant General Superintendent and General Superintendent. Later he became Manager of the Pennsylvania Co., the holding company of the Philadelphia & Erie R. R. and other leased roads. From 1888 to 1892 he was General Manager of the Buffalo, Rochester & Pittsburg R. R., which position he left to become President of the Cleveland & Marietta R. R.

Albert Victor Kellogg, Assoc. M. Am. Soc. C. E., Engineer of Maintenance-of-Way of the Sunset Route of the Southern Pacific Ry. System, died at the Santa Rosa Hospital, San Antonio, Tex., on Feb. 15. He was born at Aurora, Ill., on Aug. 4, 1863, and was the son of the late J. F. Kellogg, Professor of Mathematics at Northwestern University, Evanston, Ill. He received his education at the Northwestern University. His first work in engineering was as rodman with a locating party on the Chicago & Northwestern Ry. in 1881. In 1884 he became Assistant Engineer of the Chicago & Evanston R. R., a branch of the Chicago, Milwaukee & St. Paul Ry. The following year he accepted a similar position with the Fremont, Elkhorn & Missouri Valley R. R. In 1886 he left the railway service to become associated with the late A. Rosewater, M. Am. Soc. C. E., as Engineer in charge of surveys and construction of the sewerage systems of Grand Island, Hastings and Plattsmouth, Neb. For several years following he did a general engineering business in St. Joseph, Mo., and in Denison, Tex. Returning to railway work in 1890, he was connected with several different railways in Texas until 1904, when he was appointed to the position which he held at the time of his death.

Engineering Societies.

COMING MEETINGS.

APPALACHIAN ENGINEERING ASSOCIATION.
Feb. 24-25. Annual meeting at Pottsville, Pa. Secy., Henry M. Payne, Morgantown, W. Va.

NORTHWESTERN CEMENT PRODUCTS ASSOCIATION.
Feb. 28-March 1. Annual convention at Minneapolis, Minn. Secy., Harvey B. Smith, 834 Security Bank Bldg., Minneapolis, Minn.

ENGINEERING SOCIETY OF WISCONSIN.
March 8-10. Annual meeting at Madison, Wis. Secy., W. G. Kirchoffer, Vroman Bldg., Madison, Wis.

CANADIAN MINING INSTITUTE.
March 1-3. Annual meeting at Quebec, Que. Secy., H. Mortimer Lamb, Windsor Hotel, Montreal, Que.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.
March 7-9. Annual convention at Toronto, Ont. Secy., Wm. Snaith, 57 Adelaide St., East, Toronto, Ont.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.
March 21-23. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 962 Monadnock Block, Chicago, Ill.

AMERICAN ELECTROCHEMICAL SOCIETY.
April 6-8. Annual meeting at New York City. Secy., Jos. W. Richards, Lehigh University, South Bethlehem, Pa.

ENGINEERING SOCIETY OF WISCONSIN.—The date of the coming annual meeting at Madison has been changed from March 1-3 to March 8-10.

NATIONAL CONFERENCE ON CITY PLANNING.—The third conference will be held at Philadelphia, Pa., in May, 1911. An exhibition of city planning and housing conditions is to be held at the same time.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—A meeting will be held Friday evening, March 10, in the United Engineering Societies Building, New York City, in cooperation with the American Institute of Electrical Engineers, at which members of both societies will present papers on the cost of industrial power in central stations and isolated or industrial plants.

INSTITUTE OF OPERATING ENGINEERS.—At the second monthly meeting, to be held March 9 in the United Engineering Societies Building, New York City, Prof. Wm. D. Ennis, of Brooklyn Polytechnic Institute, will present a paper entitled "Commercial Aspects of the Work of the Operating Engineer."

OREGON SOCIETY OF ENGINEERS.—An organization under this name was effected Feb. 6, at Portland, Oregon, with an initial membership of 160 engineers and architects. The avowed object of the new society is to advance the science and practice of engineering and architecture and to maintain high professional standards. Officers were elected as follows: President, C. Henny, U. S. Reclamation Service; Vice-President, O. B. Coldwell, General Superintendent of the Railway, Light & Power Co.; Wm. R. King, of King and Wm. H. Corbett, President of the Williamette Iron & Steel Works; Secretary, C. E. Bliven; Treasurer, F. A. Naramore, Assistant Engineer of the Northwestern Bridge Co. Monthly meetings will be held at which technical papers will be read and discussed.

INTERNATIONAL NAVIGATION CONGRESS.—The twelfth congress is to be held at Philadelphia, Pa., in May, 1912. Lieut.-Col. J. C. Sanford, Corps of Engineers, is in charge of the office opened in the Bourse, Philadelphia, for attending to preliminary arrangements.

The program of questions and communications to be taken up at the meeting is as follows:

Inland Navigation.

Questions—1. Improvement of rivers by regulation and dredging and, if needs be, by reservoirs. Determination of the cases in which it is preferable to resort to such works rather than to canalization or the construction of a lateral canal. 2. Dimensions to be assigned, in any given country, to canals of heavy traffic. Principles of operating. Dimensions and equipment of the locks. 3. Intermediate and terminal ports. Best methods for combining, facilitating and harmonizing the transfer of freight between waterways and railways.

Communications—1. Application of reinforced concrete to hydraulic works. 2. Report on the works undertaken and the measures adopted or proposed for the improvement and development of lines of inland navigation, as well as for the protection of the banks of navigable highways. 3. Utilization of the navigation of large but shallow rivers. Vessels and motors.

Ocean Navigation.

Questions—1. Means for docking and repairing vessels. 2. Dimensions to be given to maritime canals. (Technical point of view. Probable dimensions of the sea-going vessels of the future.) 3. Mechanical equipment of ports.

Communications—1. High powered dredges and means for removing rock under water. 2. Report on the most recent works constructed at the more important seaports, especially those relating to breakwaters. Applications of reinforced concrete. Means for insuring its preservation. 3. Bridges and ferry bridges; tunnels under waterways used for ocean navigation. Economic and technical study. 4. Safety of navigation. Lighted buoys.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—At the 255th regular meeting held at the Engineering Societies Bldg., in New York City, Feb. 10, Mr. W. B. Jackson, of D. C. & W. B. Jackson, presented a paper entitled "Advantages of Unified Electric Systems Covering Large Territories." This paper contained (1) an analysis of conditions under which it becomes more economical to serve a larger territory from a comprehensive transmission and distribution system in place of small unrelated central-station systems in the various communities, and (2) brief descriptions of several large systems serving scattered groups of customers. The factors making these possible were summed up about as follows: (1) saving in station equipment due to non-coincident peak loads in diverse communities; (2) less investment and lower generating costs with large stations; (3) decreased reserve capacity possible; (4) savings by centralized management; (5) possibility of securing rural and suburban non-peak load; (6) development of water powers.

The discussion was not controversial and the following may be taken as characteristic. Prof. W. L. Robb, of Troy, N. Y., called attention to the predominance of hydro-electric developments in the consolidated systems. This arose largely on account of the need of developing parts of the hydro-electric plants to maximum value at the start to secure final economy—a condition which left much surplus power at first, to use which lines were thrown into new territory. Too dense population was not believed to be conducive to large extensions for while a 10,000-KW. plant could produce power cheaper than a 500-KW. plant there was not so much difference in the economy of 10,000-KW. and 20,000-KW. plants.

Mr. F. W. Darlington, of Pittsburg, maintained that obsolescence played an important part in the unification of systems. The smaller plants first designed for lighting were not adapted for mill-power supply and when additions were made for such loads still the growing demands of electric railways were not provided for. All sorts of services could be carried on the unified system for the generating plants were of such size that it made no great difference what the real load was.

Mr. Philip Torchio, of New York, claimed that a multiplicity of small stations with unrelated management tended toward inefficiency. He cited comparisons between the New York Edison Co. and the 27 separate undertakings of London, England.